MEDICAID EXPANSION IN WYOMING

ENROLLMENT AND COST PROJECTIONS

Wyoming Department of Health
February 1, 2021

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Background - Traditional Medicaid

These two background sections provide a high-level overview of the overall Wyoming Medicaid program before describing the specific circumstances around Medicaid Expansion.

What is Medicaid?

Medicaid is a **joint Federal-State social insurance program** that pays for the **medical care** and **long-term care** of **low-income and medically-needy individuals and families**. Table 1, below, illustrates the range of services that Medicaid pays for.

Table 1: General overview of Medicaid services (not inclusive)

Service type	Examples
Medical care	▪ Physician and other provider office visits ▪ Outpatient and inpatient hospital services ▪ Prescription drugs ▪ Mental health and substance abuse treatment
Extended medical benefits	▪ Dental ▪ Vision
Long-term care	▪ Facility-based / institutional services o Nursing homes o Wyoming Life Resource Center ▪ In-home services ("Home and Community-based Waivers") for people with physical or intellectual/developmental disabilities.
Other	▪ Non-emergency transportation ▪ Screenings and treatment referrals ▪ Cost-sharing for **Medicare** medical services for certain members.

Medicaid eligibility is limited

While most people on Wyoming Medicaid are low-income, this fact does not automatically qualify them for coverage; people must fall into certain **categories** based on age or physical health status.

These categories include, but are not limited to, those in Table 2 on the next page, which breaks down average monthly enrollment in SFY 2020 for the largest eligibility categories.

Table 2: SFY 2020 largest Medicaid eligibility categories by enrollment (~93% of total enrollment)

Eligibility category	Average enrollment
Low-income children	33,526
Very low-income family caretakers	6,246
On Supplemental Security Income (SSI)	5,650
Long term care - elderly and physically disabled	4,107
Individuals with intellectual/developmental disabilities	2,497
Pregnant women	1,717

Medicaid's history is part of the long history of 'poor relief' programs

The roots of Medicaid, along with other means-tested programs like food stamps or welfare, go back to the system of "indoor" and "outdoor" relief formalized by the Elizabethan Poor Laws (1597 - 1601) and adopted in the Colonies and later the United States. These kinds of local- and county-level relief programs to the poor were greatly expanded after the Great Depression, and increasingly centralized under State and Federal governments in the 1960s and 1970s.

Today's Skilled Nursing Facilities (SNFs), for example, are the current incarnation of what were called "rest homes" in the 1950s, which, in turn, evolved out of the "board and care homes" that gradually replaced the "almshouses" of the 18th and 19th centuries. In the 1940s and 50s, nursing homes began to be paid primarily through state and federal "medical vendor" programs; these were supplanted in the early 1960s by the Kerr-Mills "Medical Assistance to the Aged" program, which formed the base for Medicaid five years later.

Medicaid, as we know it today, was officially created as a voluntary State-Federal partnership in 1965 with addition of Title 19 to the Social Security Act. Wyoming began participating in July of 1967 with the passage of Senate File 183. Arizona was the last state in the Union to join, in October of 1982.

Medicaid is not Medicare

Medicare is an entirely **federal health insurance** program that pays most medical costs (and some short-term home and facility care costs) for individuals age 65 and older and certain disabled individuals under age 65.

Unlike Medicaid, the idea of Medicare developed between 1945 and 1965 as a way to provide health insurance to older Americans, who, due underwriting to their age and medical conditions, had difficulty obtaining insurance on the private market.[1] This was a relatively new problem, since health

[1] In the 1960s, 56% of Americans over 65 were not covered by health insurance.

insurance only became widespread after the medical industry was thoroughly reformed in the early 20^{th} century, and medicine actually began to prove useful to society in the 1930s and 1940s.

Medicare is a collection of four different benefit plans:

- **Part A** pays for approximately 80% of hospital and short-term nursing home and home-health services. Medicare generally does not pay for long-term care. Because of the high cost-sharing requirements of Part A and absence of an out-of-pocket maximum, many beneficiaries also purchase private "MediGap" policies to cover this risk.

- **Part B**, which is optional, covers medically-necessary office and outpatient services from physicians and other practitioners.

- **Part C**, also known as "Medicare Advantage", is an option for enrollees to replace "traditional Medicare" (Parts A and B) with enrollment in a privately-operated managed care plan.

- **Part D**, available since 2006, covers prescription drugs.

Where Medicare funding comes from a mix of sources — Medicare payroll taxes (36%), beneficiary premiums (15%) and federal general revenues (43%) — Medicaid is funded through a combination of federal general revenues and State funds.

Despite Medicaid and Medicare being distinct programs, many low-income older people can be on both programs at the same time. For these "dual-eligibles", Medicaid acts like a supplemental 'MediGap' policy, covering much of the patient cost sharing, as well as member premiums.

State administration, federal oversight

Medicaid is administered by states per agreements with the federal Centers for Medicare and Medicaid Services (CMS) known as a "State Plans". Any changes to each State Plan must be approved by CMS, but states do have significant leeway in operating their programs between certain guardrails.

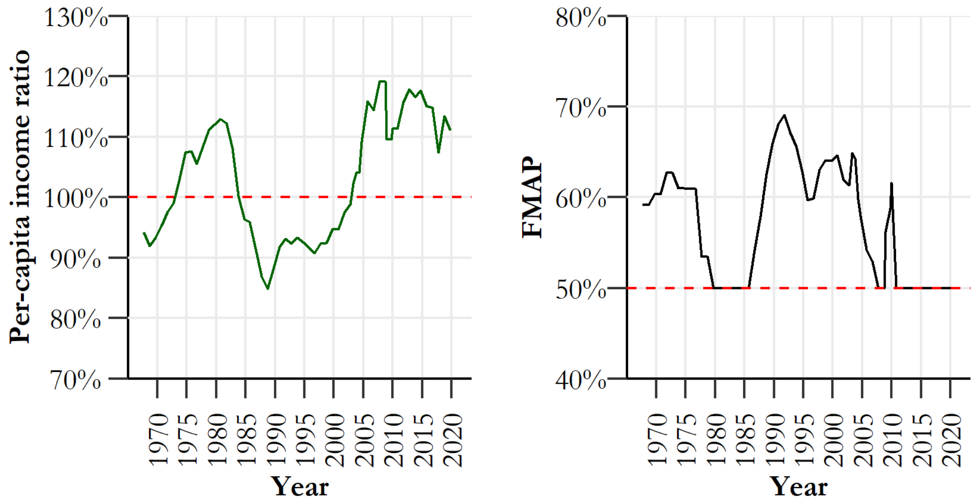
Federal matching funds are significant

Most importantly, the federal government also reimburses states a significant fraction of their Medicaid expenditures, known as the "Federal Matching Assistance Percentage" (FMAP). The match varies by state and over time, but is set by formula in proportion to the state's per-capita personal income relative to the national per-capita personal income.

For Wyoming, the FMAP we have received over the last decade has generally been around the statutory floor of 50% (with the exception of a recent temporary bump in response to the COVID-19 pandemic). Poorer states like Mississippi and West Virginia have FMAPs as high as 77%.

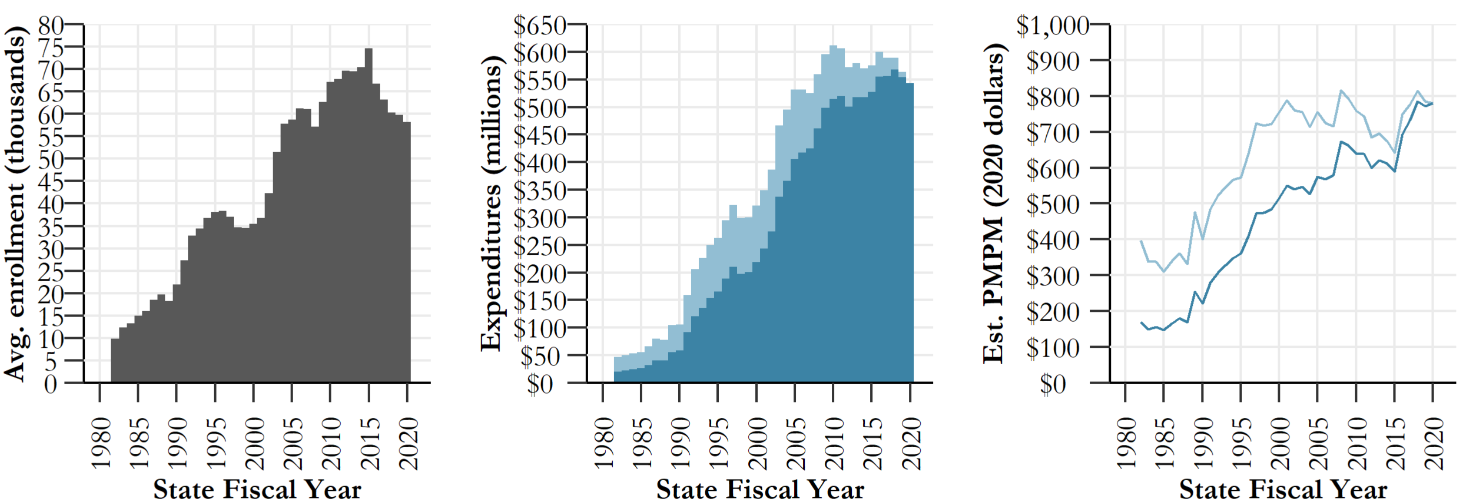
The history of Wyoming's FMAP is shown in Figure 1, below, along with the ratio of our per-capita personal income to the national figure. That trend indicates that Wyoming's FMAP will remain at the 50% floor for the foreseeable future.

Figure 1: History of Wyoming's per-capita personal income in relation to the national figure (left), and how this has affected our Federal Match (right).



Expenditures and enrollment have increased significantly since the 1980s, but have been relatively stable over the last decade.

Figure 2: Historical Wyoming Medicaid enrollment (left), expenditures (middle, with nominal expenditures in dark blue, inflation-adjusted 2020 dollars in light blue), and per-member per-month (PMPM) costs (right panel, with nominal and inflation-adjusted lines in dark and light blue, respectively)



Because eligibility is partly tied to income, enrollment in Medicaid tends to increase in bad economic times and decrease when things improve. Complicating the picture in Wyoming, however, was the implementation of a rules-based eligibility system in 2014 that has significantly tightened up eligibility decisions — note the steady decline in enrollment from 2015 to 2020.

Trends in enrollment, expenditures, and per-member per-month (PMPM) costs over the last decade are shown specifically in Table 3, below:

Table 3: Medicaid expenditures, average monthly enrollment and per-member per-month (PMPM) costs, 2010 - 2020

SFY	Expenditures	Avg. Enroll	PMPM
2010	$514,529,323	68,484	$626
2011	$519,823,344	69,756	$621
2012	$510,857,708	69,561	$612
2013	$512,934,509	69,166	$618
2014	$513,535,575	70,386	$608
2015	$524,279,441	74,812	$584
2016	$556,565,588	67,907	$683
2017	$556,274,739	63,247	$689
2018	$567,478,640	60,263	$674
2019	$554,032,539	59,826	$771
2020	$543,792,374	58,130	$779

It is important to point out, however, that the SFY 2020 figure does not reflect the recent increase in eligible persons since the COVID-19 pandemic. While the Public Health Emergency has given Wyoming Medicaid a small FMAP increase, it has also prevented the program from dis-enrolling any members. As of December 2020, Medicaid enrollment stood at **64,979**.

BACKGROUND - MEDICAID EXPANSION

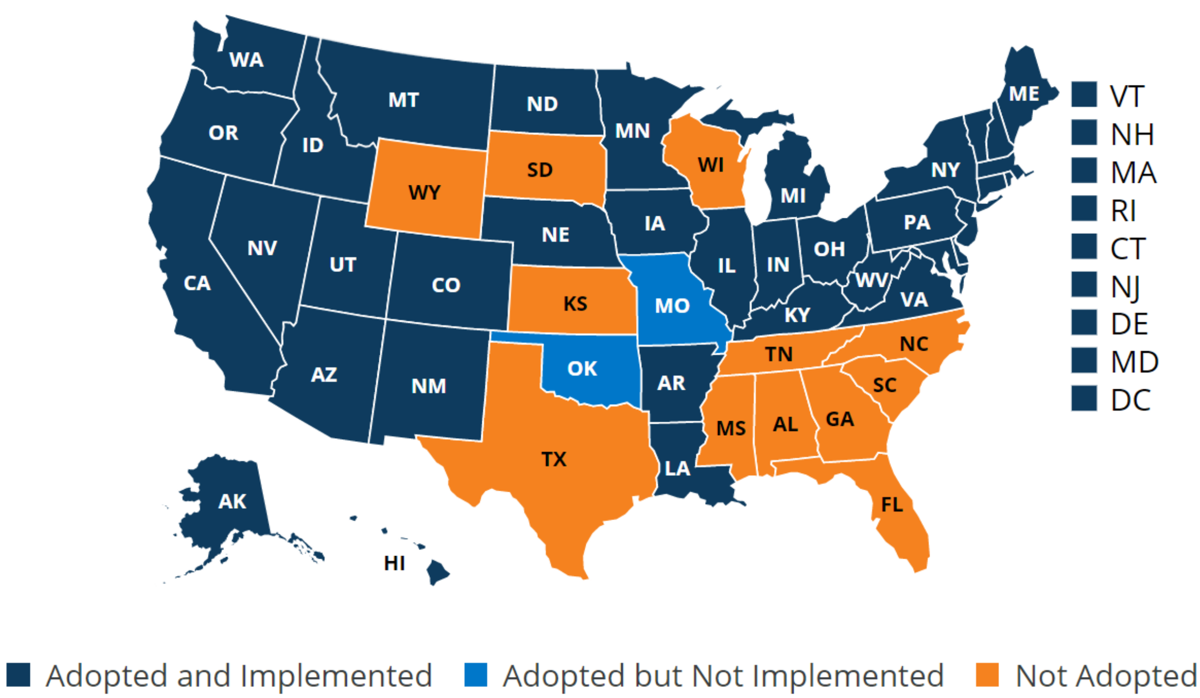
Medicaid expansion is an optional path to provide health insurance to low-income, childless adults, who otherwise have no options in this regard.

The original idea of expanding Medicaid medical coverage to low-income adults was a component of the 2010 Patient Protection and Affordable Care Act ("the ACA"). The expansion was designed to act in concert with the private insurance provisions of the ACA to allow all individuals under 400% of the Federal Poverty Level (FPL) to acquire subsidized health insurance.

The Supreme Court, however, ruled in 2012 (*National Federation of Independent Business v. Sebelius*) that a mandatory expansion of Medicaid would be unconstitutionally coercive on states. This effectively made Medicaid expansion an optional issue.

Currently, 39 states have elected to expand Medicaid; 12 have not. Figure 3, below, illustrates Medicaid expansion decision status as of February 1st, 2021.

Figure 3: Map of Medicaid expansion states[2]



[2] Kaiser Health News. https://www.kff.org/medicaid/issue-brief/status-of-state-medicaid-expansion-decisions-interactive-map/

From a pocket-book perspective, this decision has created a health insurance 'coverage gap' in the lowest-income group (0-100% of the Federal Poverty Level) because the original ACA contemplated that all of these individuals would be covered by Medicaid. Table 4, below, shows what kind of subsidized health insurance (Medicaid in purple, Exchanges in green) is available for a single, childless adult at various income levels.

Table 4: Insurance coverage options for childless adults

Income range (percent of the Federal Poverty Level)	**Upper bound income for 2021**	**Coverage options**			
		Non-Medicaid Expansion states		**Medicaid Expansion states**	
		Premium subsidy	Cost-sharing subsidy	Premium subsidy	Cost-sharing subsidy
0 - 100%	$12,880	No subsidy available		Medicaid - low to no premiums	Medicaid - low cost-sharing (plan covers >97% of average medical costs)
100 - 138%	$17,774	Plan premium capped at 2.07% of income.	Plan covers 94% of average medical costs.		
138 - 150%	$19,320	Plan premium capped at 3.10% of income.	Plan covers 94% of average medical costs.	Plan premium capped at 3.10% of income.	Plan covers 94% of average medical costs.
151 - 200%	$25,760	Plan premium capped at 4.14% of income.	Plan covers 87% of average medical costs.	Plan premium capped at 4.14% of income.	Plan covers 87% of average medical costs.
201 - 250%	$32,200	Plan premium capped at 6.52% of income.	Plan covers 73% of average medical costs.	Plan premium capped at 6.52% of income.	Plan covers 73% of average medical costs.
250 - 300%	$38,640	Plan premium capped at 8.33% of income	No cost-sharing subsidy, multiple plans available in various levels of generosity (metal levels)	Plan premium capped at 8.33% of income	No cost-sharing subsidy, multiple plans available in various levels of generosity (metal levels)
300 - 400%	$51,520	Plan premium capped at 9.83% of income		Plan premium capped at 9.83% of income	
400% +		No subsidy available			

EXECUTIVE SUMMARY

If Wyoming were to expand Medicaid to non-disabled childless adults under 138% of the Federal Poverty Level (FPL) per the Patient Protection and Affordable Care Act ("the ACA"), the Department of Health would recommend **an initial biennial appropriation of $20 million in State General Funds and $144 million in Federal Funds.** There are four important caveats:

- This estimate comes with significant uncertainty — for State Funds, we are 90% sure it will be $14 - $27 million over the first two-year period;
- It assumes an enrollment growth curve that begins at zero and continues to grow well past two years; subsequent biennial appropriations will necessarily be larger.
- It assumes a "vanilla" expansion of Medicaid, without the kind of bells and whistles that would require a waiver.
- All analyses are based on pre-COVID data, and it's unclear how long-lasting the economic effects of the pandemic will be. Additionally, the effect of any Medicaid budget cuts is not considered; currently those rate cuts would reduce costs (and revenues) by 2.5%.

Aside from the appropriation recommendation, the highlights from this analysis include:

- We anticipate approximately 24,000 new Medicaid enrollees by the end of the first biennium. This figure is higher than the original (2011) Milliman estimate, and we project both a wider range of uncertainty — with 90% of scenarios falling between 13,000 and 38,000 people at the 24-month mark — and that the 24-month estimate is only part of a larger enrollment trajectory that will continue to grow before flattening out after 36 months.
- Of those enrolling, approximately half of individuals will have incomes in the insurance coverage gap (100% FPL or less); 64% will have previously been uninsured (the remainder having some form of insurance coverage today); and ~ 60% will be employed.
- The estimated impacts of Medicaid expansion on newly-enrolled members include: a slight decrease in mortality for uninsured individuals between 45 and 64, increased healthcare utilization, improved mental health, and increased financial stability.
- Two significant second-order effects of expansion come from the "crowding-out" of private insurance coverage (i.e., previously insured members moving to Medicaid). These include:
    - Significant (~50-67%) dampening of projected revenues to providers due to Medicaid rates being lower than commercial rates, though net provider revenue will almost certainly increase.
    - A probable (though not guaranteed) 5 to 15% decrease in average per-person costs for members remaining on the Exchange. This effect is similar to the implementation of a high-risk pool.

MOTIVATION

Why revise Wyoming's original (2011) projections for Medicaid expansion? The simple answer is that experience from other expansion states has shown that actual enrollment has often exceeded original projections. This gap — between original projections[3] and actual enrollment[4] — is shown in Figure 4, below.

Figure 4: Gap between projected and actual enrollment, by state. Dark blue bars show actual enrollment, and light blue bars show original projections.

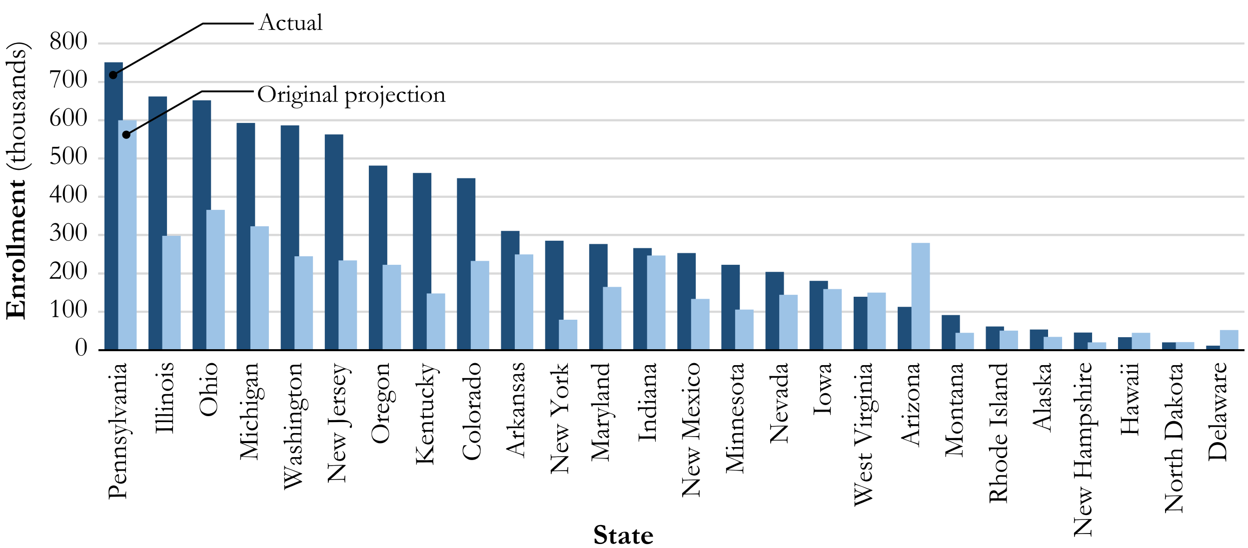


Figure 4 clearly demonstrates the need to thoroughly revise Wyoming's estimates of enrollment and costs, since many of the models used to estimate enrollment in these states may have been the same

We do so using two important principals:

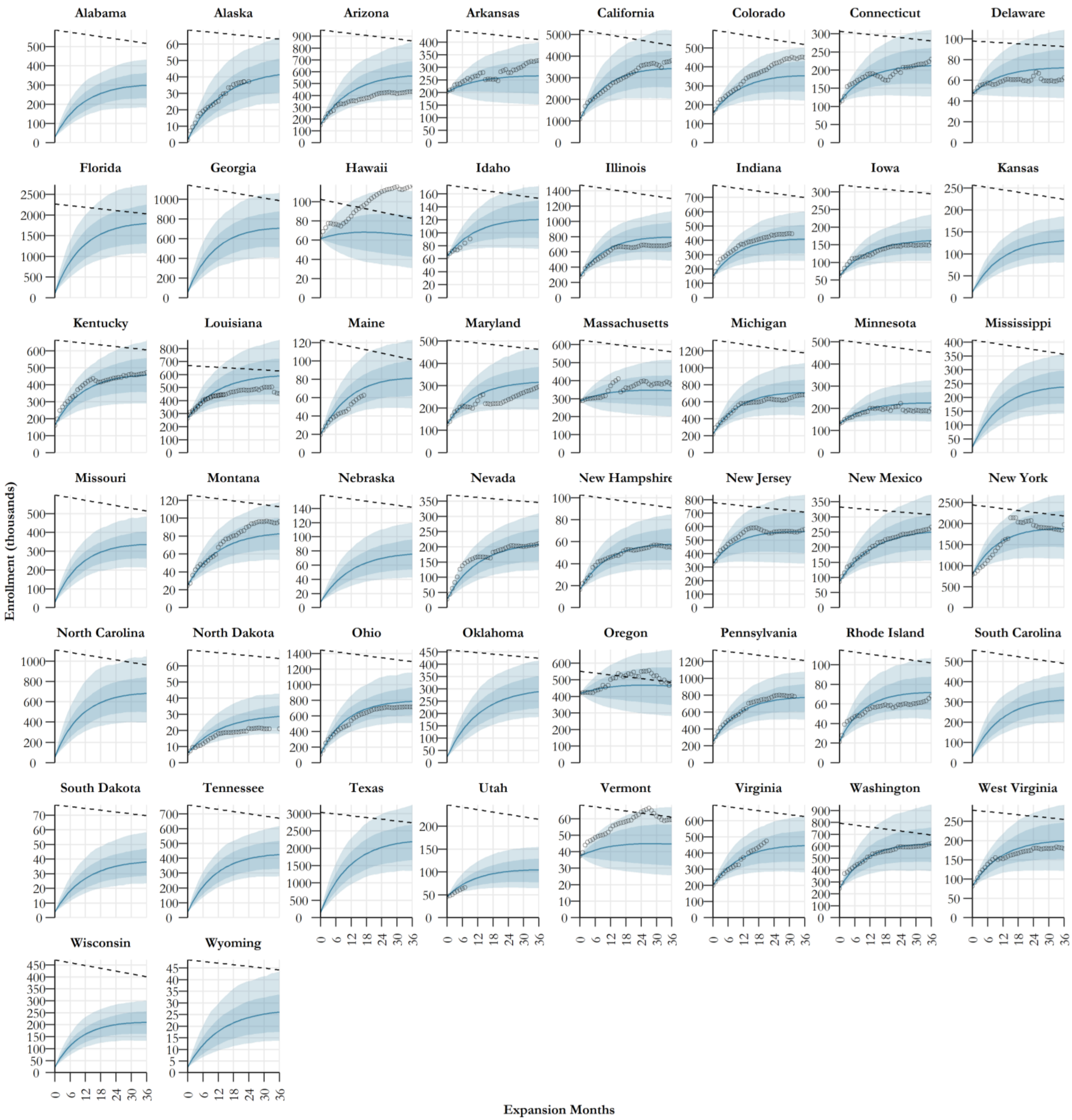
- Projections should either be based on (a) empirical data or (b) fully-explained assumptions grounded in economic theory.
- Modeling and quantifying uncertainty is just as important as making point estimates.

As a comparison, our revised estimates are built off a statistical model that estimates overall enrollment *trajectories*. Figure 5, on the next page, shows how this model (blue lines and shaded regions) fits the actual experience for expansion states (black circles) and predicts the experience of non-expansion states.

[3] Projections collected by the AP, available here: https://www.washingtontimes.com/news/2015/jul/19/projected-actual-enrollment-for-medicaid-expansion/

[4] https://www.kff.org/health-reform/state-indicator/medicaid-expansion-enrollment

Figure 5: Actual (black circles) vs. predicted (blue) enrollment trajectories and uncertainty. Dashed lines indicate SAHIE estimates of total adults under 138% FPL.



The Department has been refining these estimates each year since 2014, as more current data becomes available.

The last version of these estimates was released in December 2019; at that point, we estimated expansion would cover an estimated 20,000 people and cost the State approximately $18 million in State General Funds in the first biennium.

The models and data behind this document are largely similar to the 2019 estimates. We did, however, make some tweaks:

- New enrollment data for new expansion states (Montana, Idaho, Utah, Virginia and Maine) was added to the enrollment model.

- The demographic group denominator for the enrollment model was improved by using Small Area Health Insurance Estimates (SAHIE) data, and interpolating yearly estimates smoothly over time (i.e., per the dashed lines on Figure 2).

- We also re-parameterized the enrollment model and used 'broader' predictors (e.g., using dimension-reduction techniques like Principal Components Analysis) in order to avoid over-fitting.

- The core dataset was changed from 5-year 2013-2018 American Community Survey data to 1-year 2019 ACS data. This tradeoff reduces precision but, in theory, increases currency, though the effects of the COVID pandemic are, unfortunately, not able to be taken into account.

Ultimately, these changes have resulted in some shifts from last year's projection:

- Our enrollment projection is somewhat higher (24,000 vs. 20,000) and somewhat less certain than last year. The new enrollment model includes data from Idaho, Montana, and Utah; since both Idaho and Montana experienced higher-than-national-average enrollment trajectories, this has likely pulled up Wyoming's estimate, which was previously influenced more by lower-than-average enrollment states like North Dakota.

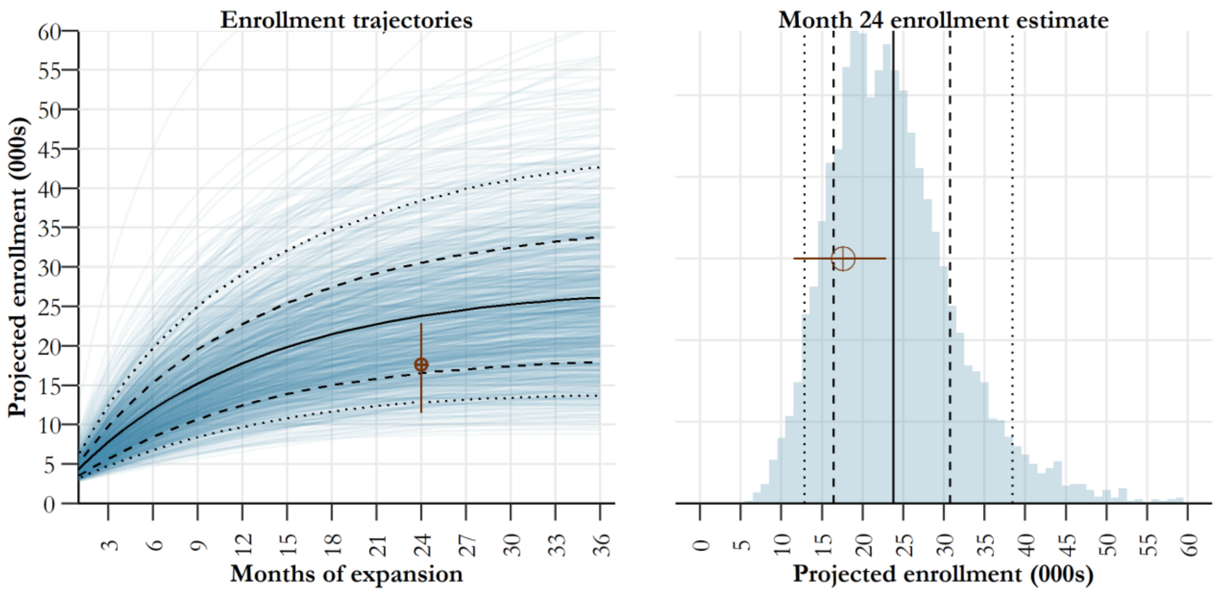
- Due to the enrollment increase, costs to the state are thus slightly higher ($20 million in SGF, vs. $18 million).

ENROLLMENT AND COSTS

Enrollment

After two years (24 months), we expect Medicaid expansion enrollment to be at approximately 24,000 people, though the count is projected to grow slightly over subsequent years before plateauing. Figure 6, below, shows the significant range of uncertainty behind this 24-month snapshot (right) and in the overall trajectories out to 36 months (left).

Figure 6: Uncertainty in enrollment



On the figures, the blue histogram (right) and blue lines (left) show the range of potential scenarios resulting from the model. In order to quantify specific ranges, we annotate this figure with three sets of intervals:

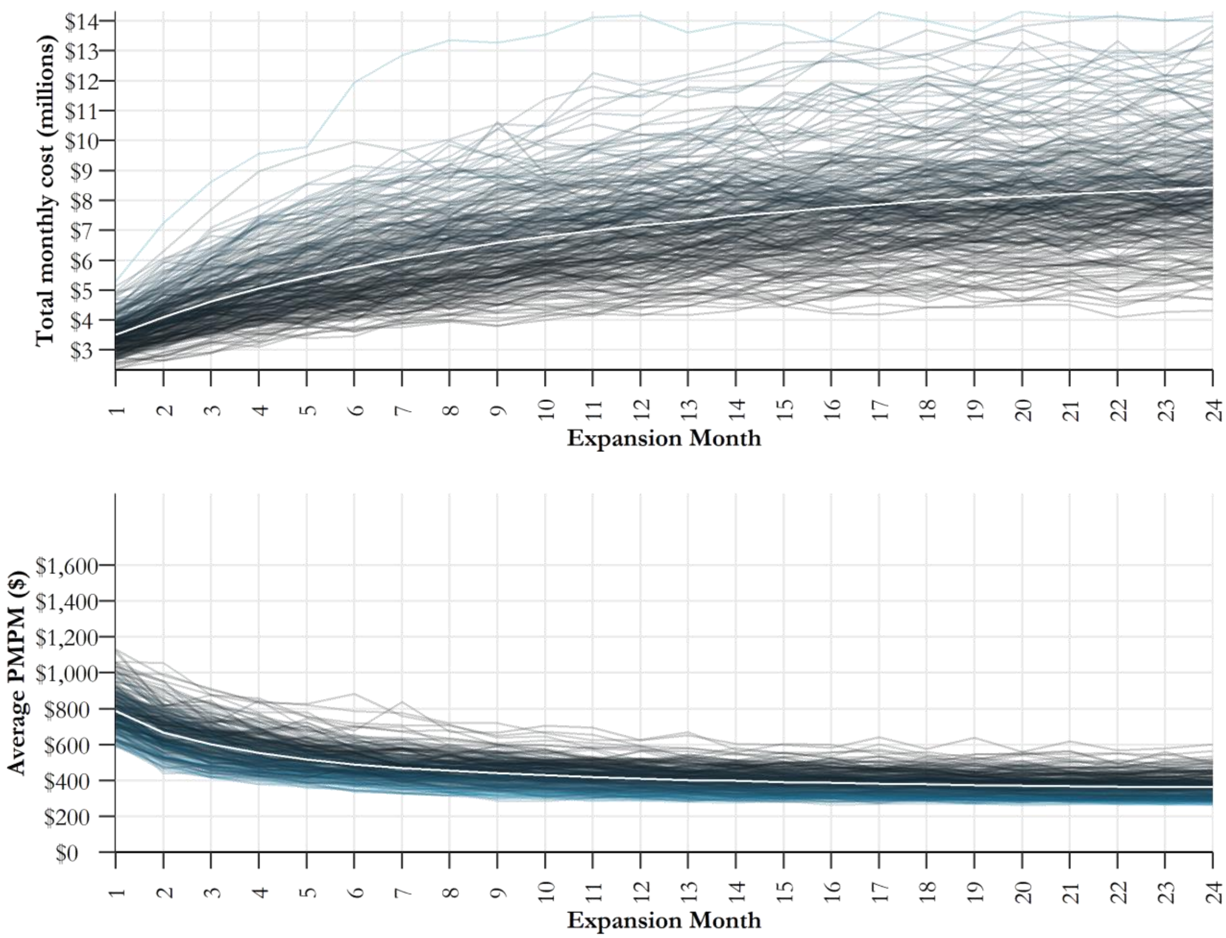
- Dashed lines represent 67% percentile (equal-tailed) intervals. This means that, working in from tails, 67% of potential scenarios lie between the dashed lines.
- Dotted lines show 90% percentile intervals.
- The brown circle and lines show estimates from Milliman (2011) and their "high" and "low" scenarios. Our estimates are roughly consistent with the original Milliman projections at 24 months, but note that the range of uncertainty is larger, and that we project a growth curve past the first biennium.

Costs

We project Medicaid medical and administrative costs for this population at ~$164 million for the first biennium. These costs will grow with a flatter trajectory than enrollment, due to the effects of adverse selection, as our model assumes that the first people to sign up for Medicaid expansion will be the least healthy and thus the most expensive to cover.

This means that, in the world of this model, enrollment has an inverse relationship with per-member per-month costs. In other words, if enrollment take-up is low, we anticipate the covered population to be sicker (and therefore more costly) than if take-up rate is high. Figure 7, below, shows the estimated trajectories for total monthly cost (upper panel) and per-member per-month medical costs (lower panel). Higher enrollment scenarios are shown as more intense shades of blue.

Figure 7: Projected monthly Medicaid expenditures (upper) and per-member per-month (PMPM) medical costs (lower). The white lines show expected values.

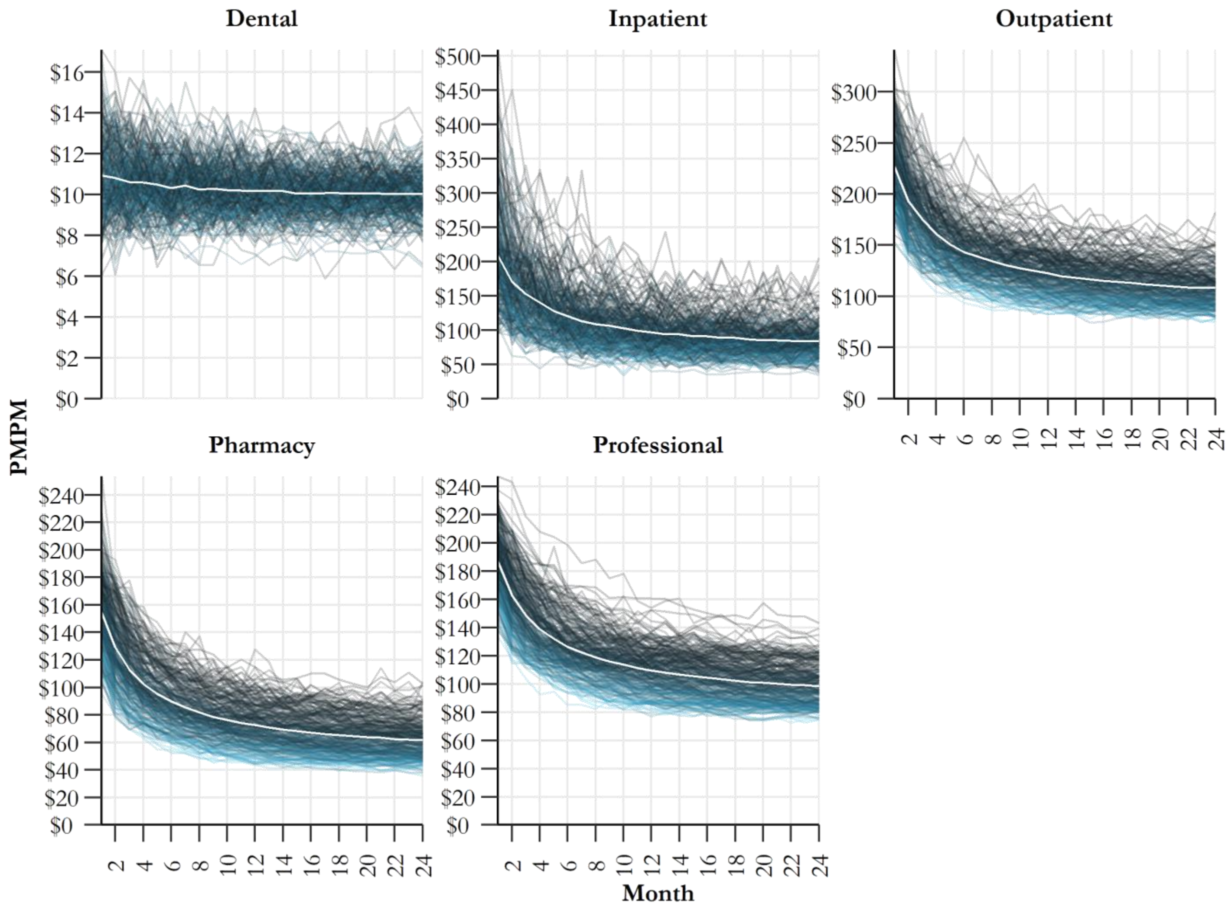


Note on the figure above that the expected total monthly costs at the end of the biennium are approximately $9 million. With no other information, this is the figure we would use to project costs for the next biennium.

Per-member per-month costs

Breaking down per-member per-month (PMPM) costs by claim type in Figure 8, below, we see a similar correlation between enrollment and PMPM — scenarios where we expect more enrollment will, generally speaking, have lower PMPM costs.

Figure 8: Modeled per-member per-month costs by service type. Blue lines represent scenarios where overall enrollment is higher. The white line shows the expectation across all scenarios.



Cost by provider category

When we combine expected expenditures by claim type with existing utilization patterns for low-income adults currently on Medicaid, we can estimate how many dollars will go to which kind of providers.

Table 5, on the next page, illustrates this breakdown of the total ~$164 million expected biennial cost. It tells us, for example, that we can expect in-State hospitals to receive ~$26.2 million in inpatient revenue and ~$24.0 million in outpatient revenue. Note, however, that crowd-out of private insurance (discussed in a subsequent section) may reduce potential revenue received by all providers, though net revenue will remain positive.

Table 5: Expected biennial expenditures by provider type and in-State vs. out-of-State location

Claim type	Expected biennial cost	Provider category	Percent of claim type[5]		Expected Expenditures	
			In-State	Out-of-State	In-State	Out-of-State
Dental	$3.9	Dental	96.6%	3.4%	$3.8	$0.1
Inpatient	$36.7	Hospital	71.3%	28.7%	$26.2	$10.5
Professional	$41.6	Ambulance	3.2%	0.4%	$1.3	$0.2
		Behavioral Health	19.2%	0.1%	$8.0	$0.0
		Dental	0.1%	0.0%	$0.0	$0.0
		Equipment / Supplies	3.2%	1.3%	$1.3	$0.5
		Laboratory/Imaging	4.2%	3.2%	$1.7	$1.3
		Other	11.4%	0.7%	$4.7	$0.3
		PT/OT	4.2%	0.1%	$1.7	$0.0
		Primary Care	17.8%	2.5%	$7.4	$1.0
		Specialist	24.6%	2.5%	$10.2	$1.0
		Vision	1.0%	0.2%	$0.4	$0.1
Outpatient	$46.2	Ambulatory Surgical Center	3.8%	0.1%	$1.8	$0.0
		Hospital	52.0%	4.4%	$24.0	$2.0
		Other	1.2%	0.4%	$0.6	$0.2
		PT/OT	0.1%	0.0%	$0.0	$0.0
		Primary Care	37.8%	0.3%	$17.5	$0.1
Pharmacy	$27.2	Pharmacy	83.1%	16.9%	$22.5	$4.6
Total medical	$155.6		85.4%	14.6%	$132.9	$22.7
Administrative	$7.8					
Total cost	$163.4					

Administrative costs

With a "vanilla" expansion (e.g., no waivers or other administrative overhead), we estimate administrative costs at 5% of total medical costs, which is consistent with the costs of the current Medicaid program. In any other scenario (e.g., waivers that change how Medicaid would administer the program or what benefits are offered), expected costs could increase.

Administrative costs pay not only for State infrastructure, but for all the marginal costs of processing additional claims and eligibility applications generated by the new members.

[5] These percentages come from existing Family Care (low-income Medicaid adult) utilization patterns.

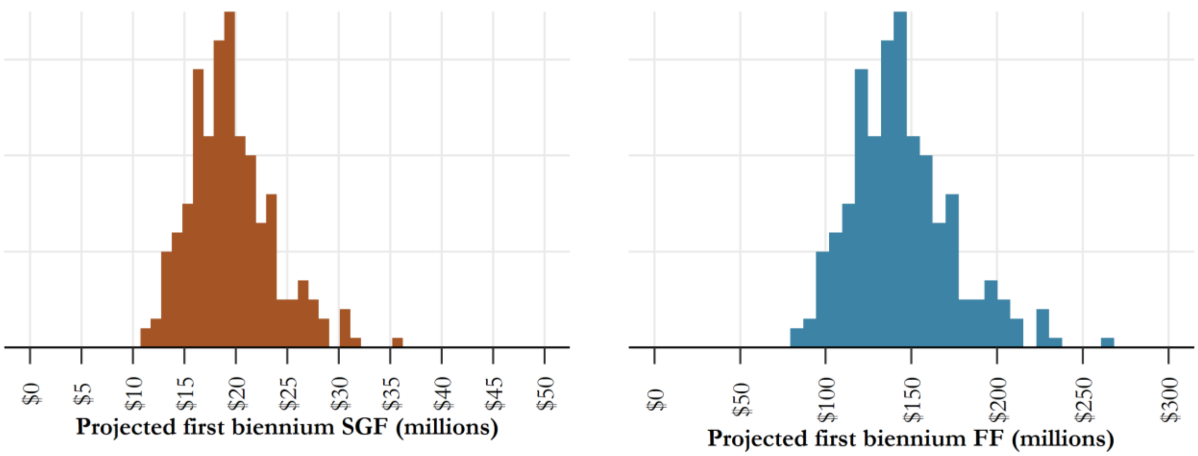
Required appropriation
In order to translate these total costs into a potential appropriation recommendation, we make some adjustments:

- Per the ACA, the Federal government will pay 90% of these medical costs after CY 2020. This only applies to a "vanilla" expansion. It's unclear what the matching percentage would be for a scenario under various Medicaid expansion waivers, but it could be lower than 90% depending on program elements and design.[6]

- The Federal government will match 50% of administrative expenditures.

Figure 9, below, shows the uncertainty in the State General Fund (SGF) and Federal Fund (FF) required expenditures for the first biennium.

Figure 9: Uncertainty in first biennium expenditures, by source



The uncertainty here is important. Our recommendation of $20 million SGF is based on the expected value, but there is some non-negligible probability that actual SGF expenditures could be as high as $27 million or as low as $13 million.

[6] FMAP for Wyoming has, in recent years, been at 50%.

ENROLLEE PROFILE

Because the simulation for enrollment and costs is based around Census data, we can take the simulation results and put together a profile of enrollees based on available demographic data.

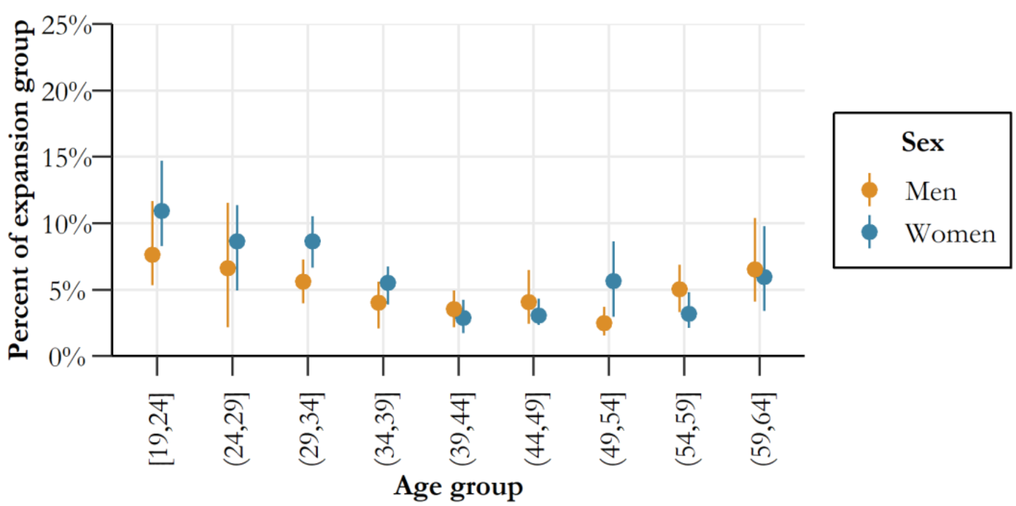
Demographics

In terms of age and sex, we characterize the Medicaid expansion population as having two broad groups:

- A group of younger (< 35 years old) enrollees, making up an estimated 48% (38 -58%) of the total population. This population will largely be female.
- An older (over 50 years old) group of enrollees, making up an estimated 29% (20 - 40%) of the expansion group.

This bimodal distribution can be seen in Figure 10, below, where orange dots and ranges show estimates for men and blue dots and ranges show estimates for women.

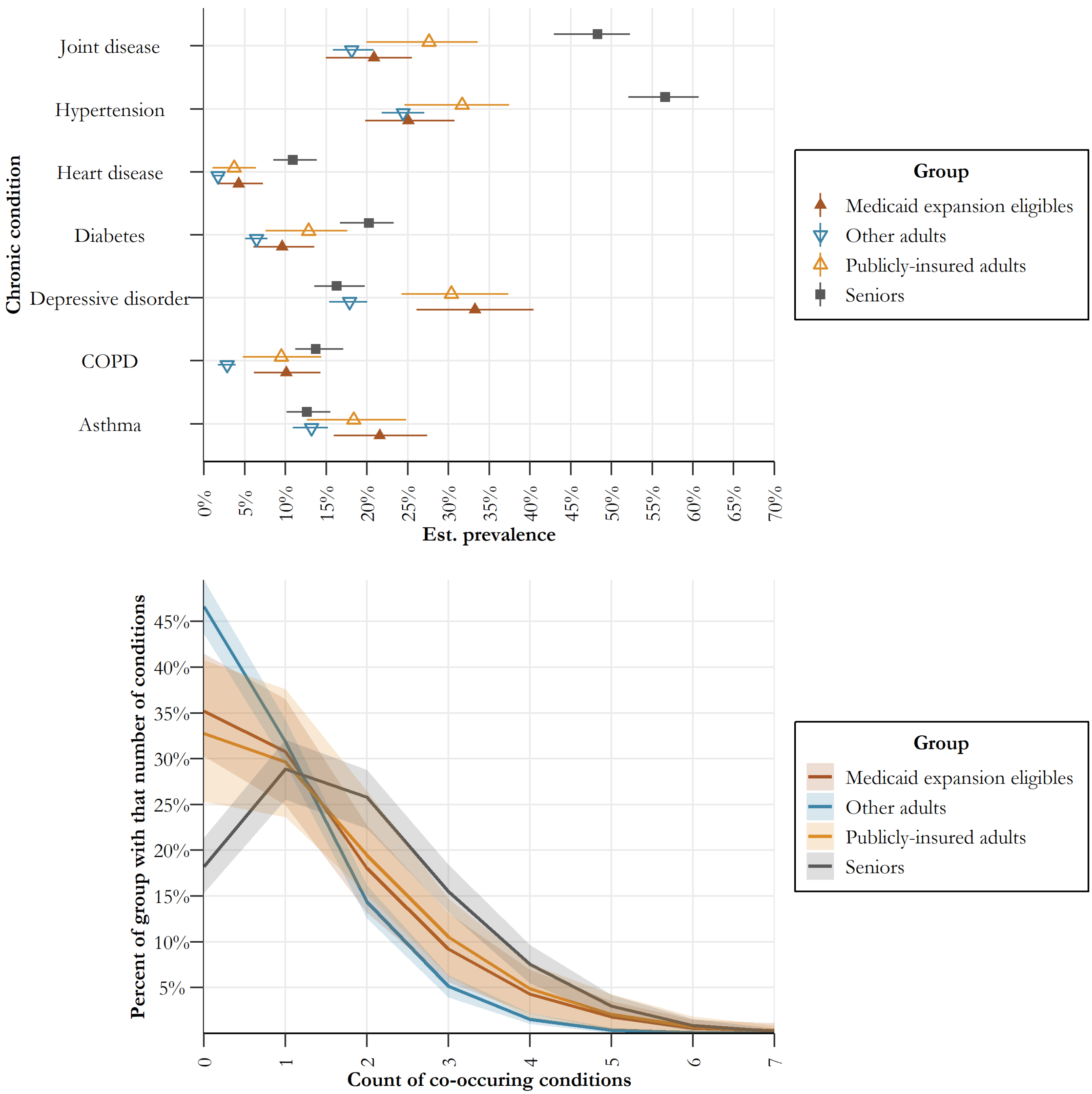
Figure 10: Age and sex estimates



Health status

Looking at seven different chronic conditions, we estimate that the expansion eligible group will be roughly similar to those adults between 18 and 64 that are currently on Medicaid or Medicare ("publicly-insured"). Figure 11, on the next page, shows our estimate of prevalence for Wyoming adults in various categories, as well as the total number of co-occurring conditions.

Figure 11: Chronic conditions



These estimates, of course, are for the total eligible, not those actually enrolled. As previously noted, the overall health of the pool will likely be negatively correlated with its size; a larger pool will be, on average, healthier. Conversely, a low-enrollment scenario will likely be less healthy, and thus have the higher per-member per-month costs seen in the lower panel of Figure 6.

Education
The vast majority of people will be high school graduates and most (~58%) will have at least some college education.

Poverty level
We estimate that approximately half (41 - 56%) of enrollees will have incomes below 100% FPL; the other half will be between 100 - 138% FPL.

Employment and insurance coverage
Approximately 60% will be employed, 34% will not be in the labor force (e.g., retired or not looking for work), and 5% will be unemployed (and actively looking for work).

Regarding insurance, we estimate that 64% (45 - 76%) of enrollees will have been previously uninsured, with the next largest fraction being the 26% (15 - 48%) that previously had directly-purchased insurance.

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Effects On Members

Aside from the obvious impact of expanding health insurance coverage and reducing the uninsured rate, many studies have attempted to estimate the effects of Medicaid expansion on newly-enrolled low-income individuals. The Kaiser Family Foundation maintains a good current summary of the literature.[7] Most of these studies, however, are observational and vary in quality and reliability.

Two studies are worthy of serious attention; both come from quasi-experimental randomized controlled trials — the gold standard for any experiment, since it offers the best chance to estimate causal effects isolated from the problems of confounding variables.

(1) The first rigorous study was conducted in Oregon, which implemented a limited expansion of Medicaid in 2008, prior to the passage of the Affordable Care Act and the availability of the optional adult Medicaid expansion. The lottery-based design of the expansion afforded researchers a unique opportunity to conduct a randomized trial.

The following summary of effects comes from a dedicated web-page for the experiment, which can be accessed at https://www.nber.org/oregon/

(a) Health utilization generally increased, specifically in the following areas:

- Hospitalizations;
- Emergency department visits;
- Office visits;
- Prescriptions, particularly for mental health and diabetes; and,
- Preventive screenings - cholesterol monitoring and mammograms

(b) Financial hardship decreased. Medicaid members reported decreases in out-of-pocket spending, catastrophic medical expenditures, medical debt, and skipped bills.

(c) Self-reported health status increased and reported depression decreased, but physical health markers did not improve by any statistically-significant degree.

- Members on Medicaid had a 25% higher probability of reporting themselves in good to excellent health compared to the control group.
- Rates of reported depression decreased by 9.2 percentage points compared to the control group baseline rate of 30 percent.

[7] https://www.kff.org/medicaid/issue-brief/the-effects-of-medicaid-expansion-under-the-aca-updated-findings-from-a-literature-review-august-2019/

- No statistically-significant changes to blood pressure, cholesterol or glycated hemoglobin were detected.

(d) There was no statistically-significant evidence that Medicaid expansion changed employment status, earnings, or receipt of government cash benefits (e.g. TANF, SSI/SSDI).

- Researchers did note a small increase in SNAP ("food stamps") enrollment.

(2) The most recent study[8] took advantage of an IRS mailing in 2017 to 3.9 million randomly-selected individuals (out of 4.5 million) who had paid a tax penalty for lacking health insurance under the ACA. The objective of the mailing was to encourage people to enroll in coverage. As with the Oregon Health Insurance Experiment, this afforded researchers the opportunity to conduct a randomized study. On average, researchers found that each letter increased insurance coverage in this group by approximately 1 year for every 87 letters sent.

(a) The most important finding from this study, however, was the **estimated reduction in mortality for previously-uninsured 45-64 year-olds over the next two years by approximately 1 death for every 1,648 individuals who were sent the letter**. The study found no evidence of a reduction in mortality for younger age groups.

This study is groundbreaking in the sense that its size and quasi-experimental nature allowed researchers to rigorously estimate the effect of health insurance coverage on a relatively-rare outcome (death).

Application to Wyoming

If we assume the expansion of Medicaid in Wyoming has an effect analogous to this IRS mailing (i.e., it represents an intent-to-treat on the whole population of eligible people, not just those who enroll), this estimate would translate into **~ 3 - 4 avoided deaths** for the approximately 6,055 (+/-870) uninsured individuals between 45 and 64 in Wyoming below 138% FPL[9] over the next two years, **who would otherwise experience ~ 50 - 70 deaths** (an estimated baseline mortality rate of 1%) in the same period.

[8] Goldin, Lurie and McCubbin. "Health Insurance and Mortality: Experimental Evidence from Taxpayer Outreach". NBER working paper No. 26533. http://papers.nber.org/tmp/91050-w26533.pdf
[9] American Community Survey 5-year PUMS (2012-16)

EFFECTS ON PROVIDERS

At first blush, Medicaid expansion would seem to be a pure benefit to medical providers in Wyoming. After all, if many previously-uninsured people are now covered by Medicaid, hospitals and physicians will see a decline in uncompensated care and bad debt, which will no doubt increase revenue (i.e., per Table 1 in the Costs section.)

Medicaid expansion will indeed reduce uncompensated care, but the actual revenue situation for providers is not so clear-cut. While we believe **net** revenues will ultimately increase, they will also be lower than total new revenue might suggest, due to the effect of "crowd-out" on private insurance.

What is crowd-out?
Many members who might be eligible for Medicaid expansion are currently covered by federally-subsidized private insurance purchased directly from the ACA Exchange.

- Here, premium subsidies (Advanced Premium Tax Credits, or APTCs) are generally available to individuals between 100 - 400% of the Federal Poverty Level (FPL), and cost sharing reduction (CSR) subsidies are generally available between 100 - 250% FPL.[10]

- Both of these subsidies make acquiring and using directly-purchased insurance fairly affordable for these income brackets.

- This situation should be contrasted with that of individuals below 100% FPL and individuals above 400% FPL, **who get absolutely nothing**.

"Crowd-out" therefore means that individuals between 100% and 138% FPL on the Exchange would almost certainly drop their private plans and enroll in Medicaid. This is for three reasons:

- Most importantly, when individuals attempt to re-enroll on the Exchange during open enrollment season, they will be administratively re-directed to enroll in Medicaid.

- These individuals have already demonstrated a need for health insurance.

- Depending on plan design, Medicaid will generally be more affordable than even these highly-subsidized plans.

[10] While the federal government has stopped paying insurers Cost Sharing Reduction subsidies, they still mandate the availability of low cost-sharing plans. In response, most insurers have significantly increased their premiums for Silver-level plans, dramatically increasing the revenue from Advance Premium Tax Credits. While this creates significant distortions between metal-level pricing, cost-sharing reduction subsidies are now effectively available from the APTC funding.

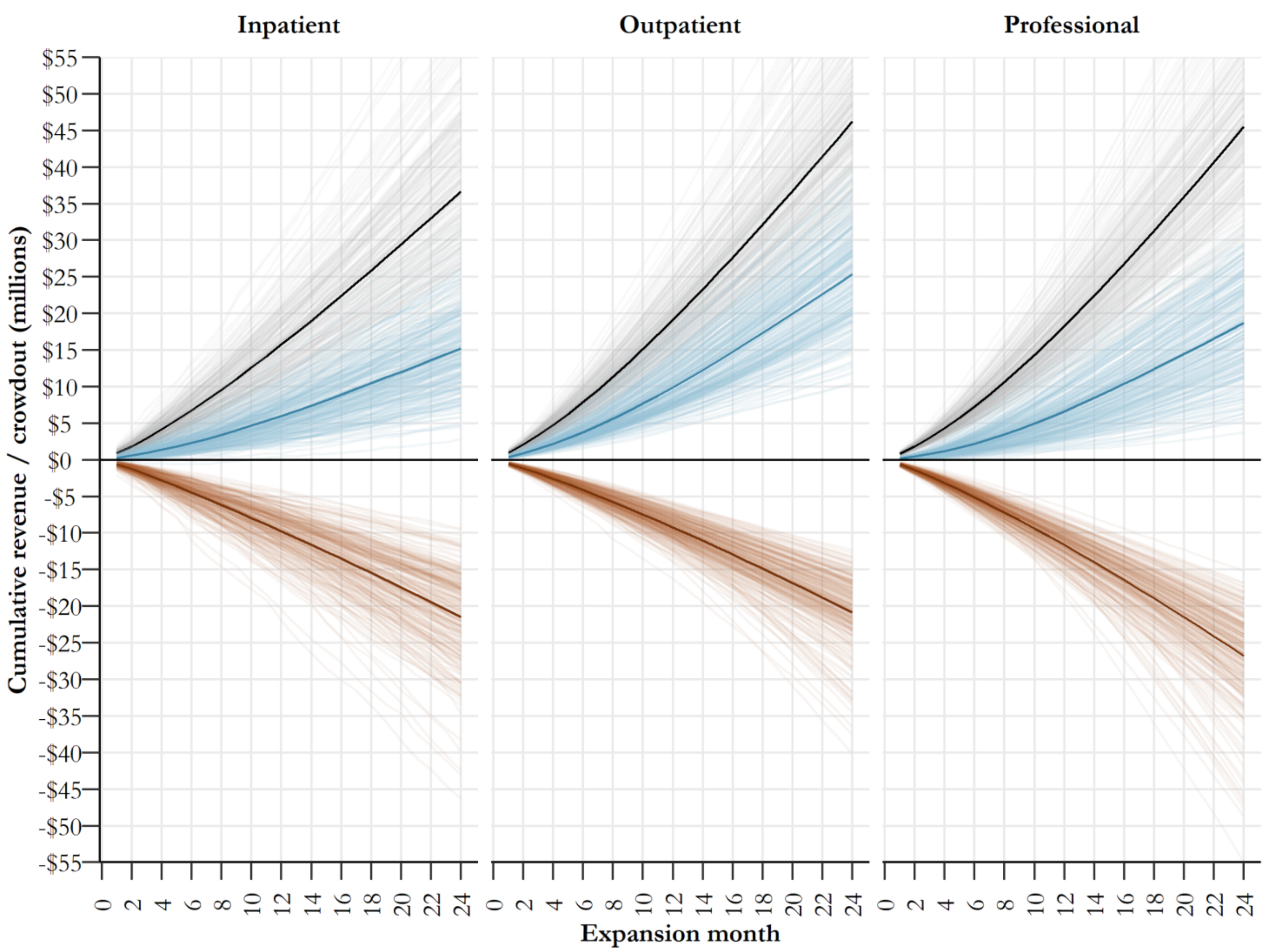
Some individuals covered by employer insurance will also move over to Medicaid, but this effect is less predictable (see the Methodology section for details on how crowd-out was implemented).

Effect on provider revenues

Generally, private insurance pays higher unit prices than Medicaid. This means that the same previously-insured individuals using the same amount of health care under Medicaid would translate into a revenue loss for their providers for those particular patients.[11]

Figure 12, below, illustrates the cumulative effect of new Medicaid revenues (in black) against the lost revenue due to crowd-out (brown), with the net revenue shown in blue. Note that in all scenarios, **net revenue is positive for providers despite crowd-out**.

Figure 12: New revenue (black), est. crowd-out (brown), and net revenue (blue)



[11] It should be noted that these lower unit prices (along with the 10% State match) also translate into probable net savings for the Federal government, but this effect is harder to estimate and will not be discussed here. Nonetheless, it does explain much of the reluctance by the Federal government to agree to partial Medicaid expansions (e.g., under 100% FPL).

To estimate these effects, we applied an estimated Medicaid-to-commercial rate ratio to the inpatient, outpatient and professional costs[12] experienced by those who were previously directly-insured or covered by employer-sponsored insurance in the simulation.

Table 6: Estimated Medicaid-to-commercial rate ratios by claim type

Claim Type	Medicaid-Commercial Ratio	Methodology	Source
Professional	0.64	Weighted average of ratios for provider types where rates were known (behavioral health, laboratory, primary care, specialist, and vision).	Navigant 2018 Medicaid rate benchmarking report.
Outpatient	0.85	Weighted average of estimated hospital aggregate rate (with UPL) and estimated FQHC/RHC rates (higher than commercial).	Milliman hospital cost study; CHIP data on FQHC/RHC payments
Inpatient	0.69	Estimated hospital aggregate rate (with UPL)	Milliman hospital cost study

For each claim type, the weighted average was calculated using existing low-income adult Medicaid utilization (by expenditure), shown in Table 5 in the costs section.

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[12] We specifically exclude pharmacy costs since changes in unit rates (a) largely accrue to out-of-state pharmaceutical companies and (b) the effects are difficult to determine due to the complications in pharmacy pricing (rebates, pharmacy benefit managers, etc.).

EFFECTS ON PRIVATE INSURANCE

The major effect Medicaid expansion has on the private insurance market is a probable reduction in Exchange pool costs somewhere between 5 - 15%. This is a positive outcome, but it is not guaranteed.

This effect is akin to that of a high-risk pool: if the sickest (and therefore, the most expensive) enrollees are moved over to Medicaid, costs *should* decrease for the rest of the private market.

The real question is: are the individuals moving from Exchange coverage to Medicaid truly sicker or more-expensive than the pool average? Available evidence indicates that they are.

- One national study estimated average cost reductions at approximately 11%[13]; the same authors more recently estimated the impact on private insurance rates if Wisconsin were to expand Medicaid at 13 - 19%.[14]

- An actuarial study of New Hampshire's Medicaid Expansion concluded that if the expansion group were removed from the Exchange, adjusted claims costs would decrease by 14%.[15]

- The Kaiser Family Foundation estimates that states that expanded Medicaid had lower aggregate risk scores on their Exchange than states that did not.[16]

Using a Census-based simulation similar to the Medicaid expansion methodology, but restricted to the population of directly-insured individuals in Wyoming[17], we also arrive at a similar estimate of reduction in modeled costs: ~10%, with a 95% credible interval between 5% and 15%.

In addition to this evidence, there are also intuitive reasons to believe that the Medicaid expansion members are likely sicker and more costly than average.

---

[13] Sen and DeLeire. "How does expansion of public health insurance affect risk pools and premiums in the market for private health insurance? Evidence from Medicaid and the Affordable Care Act Marketplaces." Health Economics. July 30, 2018. https://onlinelibrary.wiley.com/doi/abs/10.1002/hec.3809 and previous work (2016) here: https://aspe.hhs.gov/system/files/pdf/206761/McaidExpMktplPrem.pdf

[14] Sen and DeLeire. "Medicaid Expansion in Wisconsin Would Lower Premiums For Those With Private Insurance." Health Affairs blog. June 6th, 2019. https://www.healthaffairs.org/do/10.1377/hblog20190605.87178/full/

[15] Gorman Actuarial. 2016 Actuarial Analysis of NH Premium Assistance Program. https://www.nh.gov/insurance/reports/documents/08-28-17-ga-nh-pap-analysis-final.pdf

[16] https://www.kff.org/health-reform/issue-brief/data-note-effect-of-state-decisions-on-state-risk-scores/

[17] In the simulation, we apply the BRFSS model (Model 2 in the Technical Details section) to estimate the count of chronic diseases for the subset of directly-insured individuals in the American Community Survey PUMs. We then apply a MEPS-based utilization model (Model 5, based on directly-insured individuals in that survey) to estimate standardized costs based on the predicted chronic disease count and demographic factors. Simulation results are used to estimate what happens to overall enrollment and pool average costs if individuals between19-64 and below 138% FPL are removed.

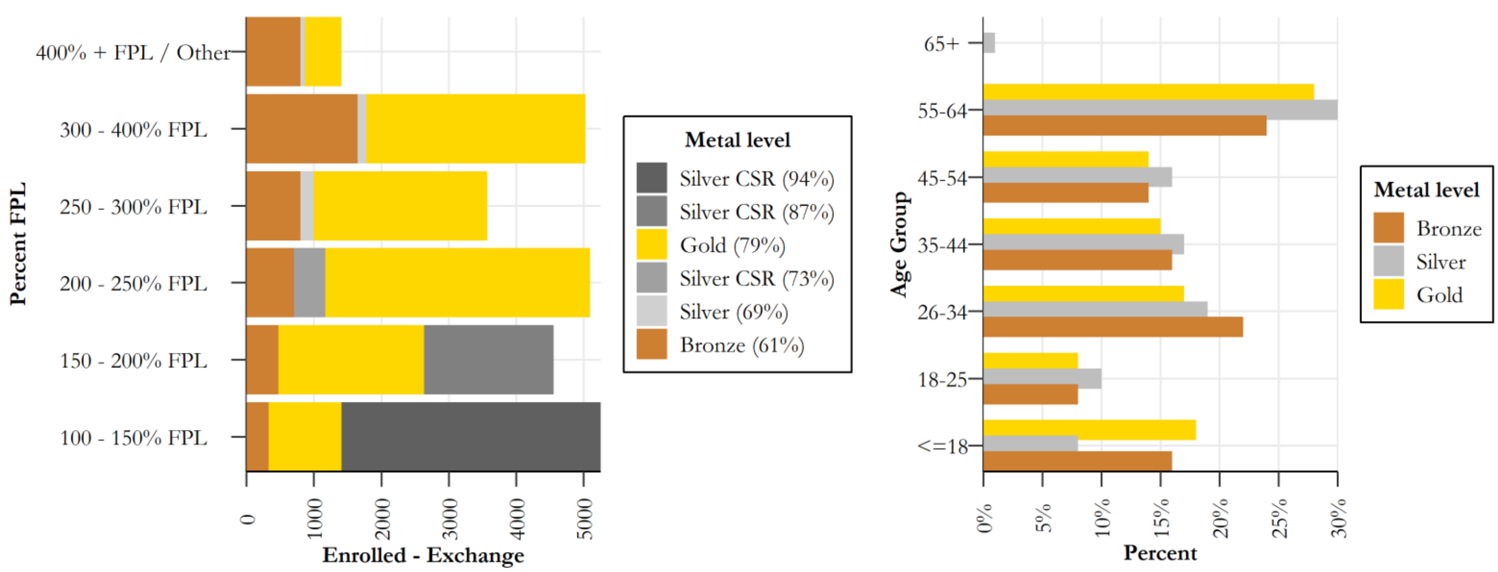
The first reason is the well-established correlation between income and health, known as the "income-health gradient."[18] On average, poorer people also tend to be sicker. So, without knowing anything else, it stands to reason that taking the poorest members of the Exchange out of the pool might improve the average health of the remaining covered lives.

The second reason is the evidence on plan selection from the Exchange itself (Figure 13, below), that provides two important takeaways:

- The closest analog to the Medicaid Expansion group (100 - 150% FPL) has largely bought the most generous plans available to them. Higher actuarial value (i.e., less cost-sharing, on average) usually translates into higher utilization because there is less 'skin in the game' for the member. Higher utilization translates into higher cost.

- On the panel to the right, it's clear that people who buy Silver plans (i.e., the bottom two income groups, where CSR Silver variants are most prevalent) are largely older than those who buy Gold or Bronze plans (the upper income groups). Older people are generally sicker and more expensive to insure than younger people.

Figure 13: 2019 Marketplace plan selections by income and age group[19]



[18] A good summary can be found here: https://www.irp.wisc.edu/publications/focus/pdfs/foc301b.pdf
[19] Data from CMS Marketplace Open Enrollment Public Use File (PUF) for Wyoming. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Marketplace-Products/2019_Open_Enrollment

Alternative scenario

This outcome, however, is not guaranteed, and Wyoming's experience may vary from these national estimates. The primary insurer on the Exchange, Blue Cross Blue Shield (BCBS) notes, for example, that there is a reasonable possibility that the health status of the enrolled population at the higher income levels may actually be *worse* than that of the low-income population that would move to Medicaid, and thus some chance that the remaining risk pool post-expansion would be most costly than the current risk pool, resulting in higher rates for the non-subsidized individuals.

This is potentially due to the unique selection effects of significant federal premium subsidies (Advanced Premium Tax Credits) that mask the traditional income-health gradient on the Exchange by making the effective price of insurance for low-income individuals dramatically cheaper than for higher-income people. This lower effective price for the member means that healthier low-income individuals (with low or zero premiums) are more likely to enroll than healthier higher-income members.

BCBS also notes that the loss of individuals purchasing mostly Silver-level plans may also reduce the value of the "silver loading" strategy to the covered members that remain.

Note on selection effects

While there is no doubt that there is a selection effect caused by the subsidies, the Department believes that these effects are more likely to happen in much higher income levels (i.e., around the 400% FPL cliff, not near 138% FPL) because the premium tax credit subsidies ramp down gradually between 100% - 400% FPL before disappearing entirely.

As shown in Figure 13, the 100 - 150% group is only ~20% of the total Exchange population. The real question is therefore whether this bottom fifth is less healthy than the much larger 150 - 400% group above it that remains, not necessarily how the 100% - 400% group compares with the 400%+ group.

Effects on State Finances

In and of itself, the expansion of Medicaid to low-income adults **will not generate any revenue** for the State of Wyoming's government. Without any State action, any additional federal funding flowing into Wyoming would go directly to medical providers.

What expansion might do is allow for potential **State-level efficiencies** by substituting a dollar of State General Funds with 10 cents of State General Funds plus 90 cents of Federal Funds in certain programs.

Over the years, the State has created a number of programs funded largely by the State General Fund (SGF) to provide safety-net health care services to the State's most vulnerable and low-income populations. If the State expands its Medicaid program, these programs, as currently conceived, would no longer need to be funded at the same levels, because individuals previously served by these programs will have access to comprehensive health insurance — either through Medicaid or through subsidized private plans on the Exchange.

These cuts are known as "offsets", and can be used to partly make up the State General Fund appropriation required to fund Medicaid Expansion. The offsets are only realized, however, if the political decision is made to **make** this substitution; i.e., by cutting State General Funds under the assumption that the providers that were paid from those Funds can make it up in Medicaid billing.

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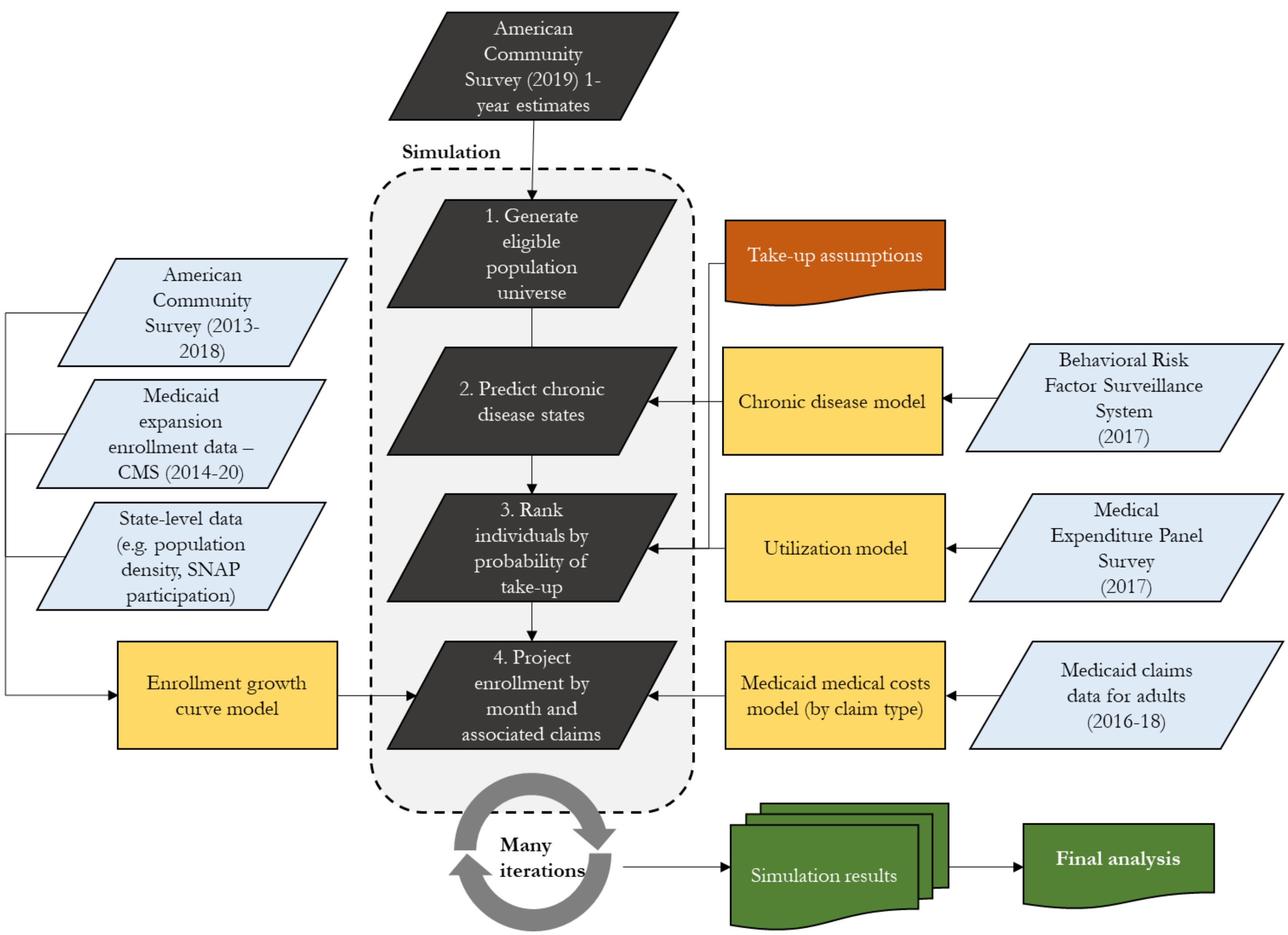
METHODOLOGY

All of the estimates in this document come from a simulation-based approach that combines the most recent and detailed Census data available for Wyoming (2019 1-year ACS estimates) with four different models to project:

- How many members will enroll in Medicaid;
- What kind of people are most likely to enroll; and,
- How much those members will incur in health care costs to the Medicaid program.

Figure 14, below, shows how the models interact with the core Census data (black) in the simulation. Narrative explaining the figure follows on the next page.

Figure 14: Medicaid expansion model framework



Generally speaking, the each iteration of the simulation follows a series of steps:

(1) We start by narrowing the universe of potentially eligible members from all Wyoming residents to civilian, non-institutionalized adults between the ages of 19 and 64 who are under 175% of the Federal Poverty Level.[20] We also exclude individuals who already have Medicare or Medicaid as their primary insurance.

- Using the person-level and replicate weights included in the Public Use Microdata Sample (PUMS), we estimate an expected total (this happens to be 48,316 in the 2019 1-year ACS data) and standard deviation (3,377) for this subset of people. We then draw a value from this (assumed normal) distribution to use as the eligible population count for each iteration of the simulation. This allows us to propagate at least some of the measurement error of the Census microdata into the results.

- We use the replicate weight variable with the total number of people closest to this draw as the base weight for each iteration, and then use it to expand the Census microdata samples into a simulated group of people. In this case, there are 468 observations in the survey data that are repeatedly expanded into some number between 42K and 54K "people". Note that using the 5-year ACS PUMS would have resulted in a more granular sample (~5x the data), but also one that would have been less current.

(2) Now we need some mechanism to **sort** the simulated group of people by their propensity to enroll in Medicaid. To do this, we make the assumption that those individuals with higher expected personal healthcare costs are more likely to enroll than those without. This is due to adverse selection (e.g., sicker people are more likely to need insurance), but also to the fact that eligibility in Medicaid can be 'retroactive,' which allows for many of the sickest members to automatically be enrolled *post hoc* if the hospital they end up in finds they are uninsured.

- The first step is to predict the **total number of chronic conditions** (out of 10 measured) in each simulated person, based on their age, sex, race/ethnicity, household income, veteran status, whether they own or rent, employment status and insurance type. The **chronic disease model** (Model 2 in the next section) is based on restricted 2017 survey data collected in Wyoming by the Behavioral Risk Factor Surveillance System (BRFSS).

- Using the same demographic data plus the predicted number of chronic conditions, we then predict **expected (average) standardized[21] health care costs** for the simulated individuals

[20] The actual income eligibility criteria for Medicaid expansion is 138% of FPL, but the simulation allows for the potential of individuals close to the eligibility criteria to intentionally reduce their income in order to qualify for health care coverage. This was done in response to surprisingly high take-up rates in some expansion states, but it does not materially affect the overall enrollment projections.

[21] In the MEPS data, both total expenditures and utilization (visits / prescriptions / inpatient stays) are surveyed. Since prices differ across payers, we calculate average prices by aggregating expenditures and dividing by aggregate units for

using a model built off of 2017 Medical Expenditure Panel Survey (MEPS) data (Model 3, in the next section). While this is a national dataset (not Wyoming-specific), it covers a large universe of individuals (e.g., including the uninsured), and contains a lot of demographic information that helps model annual health care costs.

What we're basically doing in these first two steps is generating an extensively-underwritten health insurance premium for each simulated person.

- After each member is assigned an expected total cost, we use the following **simplifying assumptions** to modify that total cost into an estimated *personal* cost (e.g., out-of-pocket costs to the individual). These include:

    - Insured individuals, whether with employer-sponsored insurance (ESI) or directly-purchased insurance, will only personally face 20% of their costs, with a maximum out-of-pocket of $5,000.[22]

    - Uninsured individuals (including those with only VA/TRICARE or IHS) will only have a willingness-to-pay that is ~20% - 35% of their total costs.[23] Health care economists generally believe this is due to the moral hazard effects of EMTALA and uncompensated/ charity care.

    - Individuals with ESI will face an approximate "hassle cost" of $1,000 in order to switch from their employer plan to Medicaid.

    - Individuals with directly-purchased insurance who are below 138% (i.e., those currently purchasing insurance on the individual ACA marketplace) will be prodded automatically to enroll in Medicaid (and subsidies for this population would be unavailable). We model this as a strong incentive of -$1,000.

  At this point, the list of individuals in the simulation is sorted by a "willingness to pay" for Medicaid coverage.

(3) Based on the **state-level enrollment model** (Model 1 in the next section), we draw a random enrollment trajectory, which estimates the total number of people enrolled in Medicaid for each month. These trajectories can be seen in the right panel of Figure 2 in the Enrollment section.

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each utilization category (e.g., total ED costs / total ED visits). We then apply the average price for each category to the units reported by each person and add up total standardized costs to use as the outcome variable.

22 This is based on the 20% coinsurance and approximate MOOP in the State Employees Group Insurance plan.

23 Finkelstein, et. al. "Subsidizing health insurance for low-income adults: evidence from Massachusetts." National Bureau of Economic Research. Working Paper 23668. Page 31. Finkelstein also cites three other papers with similar estimates.

For each month of the trajectory, we fill the required number of people by drawing from the top of the "willingness to pay" list and "enrolling" them in Medicaid. This means that the people enrolling in Month 1 will also be enrolled through Month 24. We do not attempt to model churn (people losing eligibility), though this would likely be more realistic.

(4) At this point in the simulation, we have a list of Medicaid member-months, with individual demographic characteristics for all the people enrolled. Now we use the **Medicaid claims data model** (Model 4) to estimate monthly health care costs by five different claim types - Inpatient, Outpatient, Professional, Pharmacy and Dental.

Because of its structure, this model allows us to assume utilization across claim types are correlated within individuals; for example, someone with a lot of inpatient services is also likely to have a lot of professional medical claims.

These four steps show what happens inside one single iteration of the simulation.

Repeating the simulation for many iterations — all the while using different random draws from each model — allows us to propagate uncertainty through to the final estimates. Due to time restrictions, we ran 261 iterations of the simulation. This is adequate for the expected values and intervals presented in this document, but obviously more would have been better. In future iterations of this project, we need to explore more efficient simulation methods to increase the number of iterations generated in a fixed period of time.

Once the simulations are complete, analysis is relatively straightforward: we just ask questions of the results. How many men versus women? How many 45-50 year olds are uninsured? And so forth. The expectation (mean) of all iterations gives us the central estimate, and the remaining uncertainty in the results can be quantified by the uncertainty intervals you see throughout this document.

MODELS

All models were fit using Stan[24], with R statistical software and the brms package[25] as the interface. We used the data.table[26] and lubridate[27] packages to clean and process data, and the ggplot2[28] package to create final graphics.

Output from the brms models is shown in the next few pages. The output shows the model specification (written in lmer-like syntax), the data used, the distributional family assumed, estimates for unobserved variables, and MCMC diagnostics. Information on priors is not included in the output, but is available on request. Generally speaking, regularizing priors (e.g., Normal(0,1) for coefficients on a log or logit scale) were chosen to improve computation.

[24] Stan Development Team. 2018. RStan: the R interface to Stan. R package version 2.17.3. http://mc-stan.org
[25] Paul-Christian Bürkner (2017). brms: An R Package for Bayesian Multilevel Models Using Stan. Journal of Statistical Software, 80(1), 1-28.<doi:10.18637/jss.v080.i01>
[26] Matt Dowle [aut, cre], Arun Srinivasan [aut], Jan Gorecki [ctb], Michael Chirico [ctb], Pasha Stetsenko [ctb], Tom Short [ctb], Steve Lianoglou [ctb], Eduard Antonyan [ctb], Markus Bonsch [ctb], Hugh Parsonage [ctb]
[27] Garrett Grolemund, Hadley Wickham (2011). Dates and Times Made Easy with lubridate. Journal of Statistical Software, 40(3), 1-25. URL http://www.jstatsoft.org/v40/i03/
[28] H. Wickham. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York, 2016.

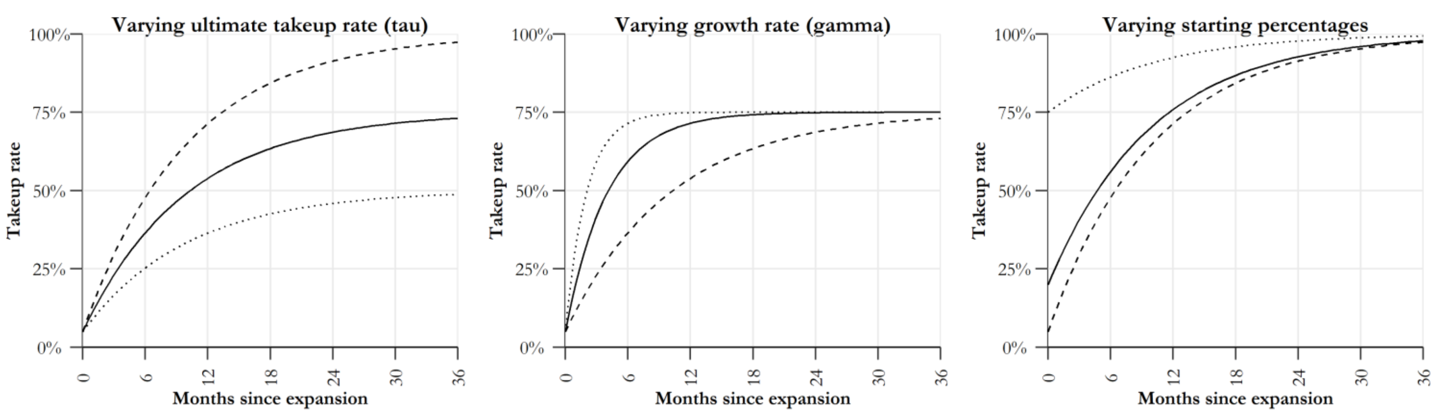
1. Enrollment model

This model attempts to estimate how Wyoming's enrollment experience may trend based on characteristics it might share with other states. The core of the enrollment model comes from monthly state Medicaid enrollment figures from CMS, covering January 2014 to December 2016.[29] These data show the enrollment trajectories for states at various stages of expansion; where some expanded Medicaid as soon as the opportunity was available (California, Colorado), others expanded later (Montana, Alaska, Louisiana).

After adding manually-gathered enrollment trajectories for states that have expanded since the CMS data expired (e.g., Maine, Idaho, Virginia, Utah), we modeled enrollment trajectories using a parametric equation built around exponential decay, with enrollment starting at some initial level and growing more and more slowly to an asymptote defined by a percentage of the Small Area Health Insurance Estimate (SAHIE) estimate of the total eligible population. We estimated the takeup rate (tau) and growth rate (gamma) parameters as linear combinations of state-level predictors, along with correlated state-level varying intercepts.

Figure 15, below, illustrates how the three parameters of the model affect the shape of the projected enrollment curve.

Figure 15: Medicaid enrollment model parameters



Ultimately, the model with the most predictive value included the following state-level predictors:

- Four components from a correspondence analysis done on employment data by economic sector (NAICS).
- Two components from a Principle Components Analysis (PCA) done on America's Health Rankings (AHR) data.
- Population density and percentage of the population on food stamps (SNAP).
- State locations within the US, modeled as a Markov Random Field smooth.

[29] https://data.medicaid.gov/Enrollment/Medicaid-Enrollment-New-Adult-Group/pfrt-tr7q

```
Family: gaussian
  Links: mu = identity; sigma = log
Formula: Takeup | weights(Weight) ~ StartingPct + (exp(tau) - StartingPct) * (1 -
                                   exp(-1 * exp(gamma) * ExpansionMonths))
         tau ~ 1 + (1 | state | State) + ESI + Uninsured + eCA1 + eCA2 + eCA3 + eCA4 +
               HR_1 + HR_2 + lDensity + PctSNAPAll + s(StateF, bs = "mrf", k = 30, xt
               = list(nb = nb))
         gamma ~ 1 + (1 | state | State) + StartingPct + lDensity + PctSNAPAll +
                s(StateF, bs = "mrf", k = 30, xt = list(nb = nb))
         sigma ~ 1
   Data: model_dataset_reduced (Number of observations: 1206)
Samples: 4 chains, each with iter = 2000; warmup = 500; thin = 1;
         total post-warmup samples = 6000

Smooth Terms:
                     Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sds(tau_sStateF_1)       0.33      0.22     0.01     0.82 1.00      930     1855
sds(gamma_sStateF_1)     0.39      0.30     0.01     1.11 1.00     1176     2085

Group-Level Effects:
~State (Number of levels: 50)
                                   Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(tau_Intercept)                      0.26      0.06     0.16     0.38 1.00     1739     1745
sd(gamma_Intercept)                    0.45      0.09     0.30     0.64 1.00     2323     3126
cor(tau_Intercept,gamma_Intercept)    -0.67      0.18    -0.95    -0.24 1.00     1234     1821

Population-Level Effects:
                  Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma_Intercept      -3.66      0.02    -3.70    -3.62 1.00    10694     4395
tau_Intercept        -0.84      0.80    -2.38     0.74 1.00     3115     3786
tau_ESI              -1.03      1.38    -3.80     1.55 1.00     2836     3545
tau_Uninsured         0.85      0.98    -1.16     2.69 1.00     2940     2965
tau_eCA1              0.09      0.08    -0.07     0.25 1.00     2596     3104
tau_eCA2              0.04      0.05    -0.06     0.13 1.00     3088     3653
tau_eCA3              0.07      0.06    -0.05     0.18 1.00     2756     3494
tau_eCA4             -0.04      0.09    -0.21     0.13 1.00     2697     3471
tau_HR_1              0.07      0.16    -0.25     0.38 1.00     3067     3720
tau_HR_2             -0.13      0.36    -0.87     0.56 1.00     1867     2666
tau_lDensity          0.06      0.13    -0.20     0.31 1.00     1958     2820
tau_PctSNAPAll        2.09      1.62    -1.06     5.33 1.00     3063     3341
gamma_Intercept      -2.56      0.20    -2.95    -2.16 1.00     4146     4287
gamma_StartingPct    -0.11      0.51    -1.12     0.87 1.00     3190     3340
gamma_lDensity        0.07      0.10    -0.14     0.25 1.00     2509     2854
gamma_PctSNAPAll     -0.03      0.91    -1.81     1.72 1.00     7852     4837
```

2. Chronic disease count model

This model draws upon Wyoming Behavioral Risk Factor Surveillance System (BRFSS) microdata to estimate the total count of 10 potential chronic diseases in individuals based demographic factors that are also available in the American Community Survey Census data (race/ethnicity, veteran status, employment, household income, insurance status, age and sex). We also include varying effects for survey meta-data (interviewer, county, month).

The specific diseases included in this count include:

- Heart disease;
- Heart attack in last twelve months;
- Hypertension;
- Diabetes;
- Chronic Obstructive Pulmonary Disease (COPD);
- Depression / mood disorder;
- Joint disease;
- Asthma;
- Skin cancer;
- Other cancer.

Since this is a count model, we use a Poisson likelihood with log-link on the linear predictors.

```
Family: poisson
  Links: mu = log
Formula: Chronic ~ 1 + s(zAge, by = MALE) + RACE + OWNRENT + VETERAN + EMPLOYMENT + INCOME +
INSURANCE + (1 | IMONTH) + (1 | INTVID) + (1 | COUNTY)
   Data: wy_2017_subset (Number of observations: 4463)
Samples: 4 chains, each with iter = 3000; warmup = 1000; thin = 1;
         total post-warmup samples = 8000

Smooth Terms:
                  Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sds(szAgeMALE0_1)     0.85      0.31     0.40     1.60 1.00     4568     5593
sds(szAgeMALE1_1)     0.85      0.35     0.37     1.72 1.00     4248     5854

Group-Level Effects:
~COUNTY (Number of levels: 23)
              Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(Intercept)     0.07      0.02     0.03     0.11 1.00     3372     3618

~IMONTH (Number of levels: 12)
              Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(Intercept)     0.02      0.01     0.00     0.05 1.00     4289     3731

~INTVID (Number of levels: 424)
              Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(Intercept)     0.06      0.03     0.01     0.11 1.00     1374     1999

Population-Level Effects:
                     Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
```

Intercept	0.63	0.12	0.39	0.86	1.00	4770	5920
RACEAsian	-0.30	0.32	-0.95	0.31	1.00	10917	5819
RACEBlack	-0.20	0.19	-0.57	0.16	1.00	7142	5851
RACEHispanic	-0.04	0.12	-0.26	0.19	1.00	4433	5855
RACEOther	0.00	0.14	-0.26	0.27	1.00	5107	6497
RACEWhite	-0.07	0.10	-0.27	0.14	1.00	4134	5428
OWNRENT	-0.23	0.03	-0.30	-0.17	1.00	11243	5982
VETERAN	0.04	0.03	-0.03	0.11	1.00	13607	5843
EMPLOYMENTNILF	0.31	0.03	0.25	0.37	1.00	12369	6710
EMPLOYMENTUnemployed	0.25	0.06	0.13	0.37	1.00	13951	6623
INCOME25K	-0.12	0.05	-0.22	-0.02	1.00	4327	5753
INCOME35K	-0.21	0.06	-0.32	-0.09	1.00	4524	5572
INCOME50K	-0.26	0.05	-0.36	-0.15	1.00	4285	5867
INCOME50Kplus	-0.39	0.05	-0.49	-0.29	1.00	3706	5660
INCOMEOther	-0.39	0.05	-0.49	-0.28	1.00	4461	6271
INSURANCE	0.14	0.05	0.04	0.23	1.00	14550	6007
szAge:MALE0_1	0.56	0.82	-1.09	2.11	1.00	6128	5321
szAge:MALE1_1	1.09	0.85	-0.66	2.68	1.00	6647	5668

Utilization models

Both the MEPS and Medicaid models are built to model two unique features of aggregate health care costs:

- A significant number of zero-cost person-periods, for people that do not use any health care in the time period.
- For those who do use care, the costs have a skewed distribution with a long right tail, due to the few individuals who may have extremely high costs in that period.

Structurally, therefore, they are built around similar distributional assumptions, so we use the same "hurdle lognormal" framework, where probability of any costs are modeled first (the "hurdle"), and if there are costs in the time period, those costs are modeled using a lognormal distribution.

There are, however, several important differences between the two models:

- The MEPS model uses more demographic predictors (e.g., insurance status, educational attainment, race) that aren't available in the Medicaid data. Both use age and the count of chronic conditions estimated in Model 2.
- Where the MEPS model is straightforward (e.g., annual costs per person), the Medicaid model is hierarchical, in the sense that data for member-months are nested both within members (e.g., "Bob") and months ("January").

  The Medicaid model therefore takes advantage of this hierarchical nature to estimates varying intercepts for both individual members, effectively allowing us to simulate "sicker" and "healthier" people in the data.

- Where the MEPS model looks at total cost, the Medicaid claims model considers five different components of cost simultaneously (inpatient, outpatient, professional, dental, and pharmacy). The model also leverages the individual varying-intercepts structure to estimate correlations within individuals between the five claim types for the hurdle component (probability of using care).

- The MEPS model is fit on nationally-representative survey data. The Medicaid claims model is fit on Wyoming Medicaid claims data for low-income (Family Care) adults and "children" between the ages of 19 and 64.

3. MEPS utilization model

```
Family: hurdle_lognormal
  Links: mu = identity; sigma = identity; hu = logit
Formula: UScore ~ 1 + Male + s(zAge, zChronic, zPOV) + (1 | VARSTR)
         hu ~ 1 + Male * zAge + zChronic + zPOV + (1 | VARSTR)
   Data: model_sample (Number of observations: 4875)
Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
         total post-warmup samples = 4000

Smooth Terms:
                            Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sds(szAgezChroniczPOV_1)        2.44      0.40     1.73     3.30 1.00     3041     3074

Group-Level Effects:
~VARSTR (Number of levels: 165)
                  Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(Intercept)         0.16      0.03     0.09     0.22 1.00     1639     1799
sd(hu_Intercept)      0.24      0.07     0.09     0.35 1.00      898      789

Population-Level Effects:
                     Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
Intercept                7.50      0.03     7.44     7.56 1.00     6866     3351
hu_Intercept            -5.50      0.24    -5.98    -5.03 1.00     7588     3074
Male                    -0.25      0.04    -0.32    -0.17 1.00    10009     2732
hu_Male                  0.74      0.07     0.60     0.88 1.00    10703     2843
hu_zAge                  0.15      0.09    -0.02     0.32 1.00     6073     3280
hu_zChronic             -3.15      0.17    -3.48    -2.82 1.00     7476     3073
hu_zPOV                 -0.28      0.04    -0.35    -0.20 1.00    11054     2649
hu_Male:zAge            -0.58      0.12    -0.81    -0.34 1.00     5624     2942
szAgezChroniczPOV_1     -0.01      0.96    -1.89     1.89 1.00     9405     3220
szAgezChroniczPOV_2     -0.91      0.59    -2.11     0.26 1.00     6112     2844
szAgezChroniczPOV_3      0.01      0.97    -1.87     1.93 1.00    10290     2930
szAgezChroniczPOV_4      0.84      0.95    -1.05     2.66 1.00     9356     3079
szAgezChroniczPOV_5     -1.25      0.97    -3.09     0.63 1.00     8481     3305
szAgezChroniczPOV_6     -0.87      0.60    -2.04     0.31 1.00     7420     3268
szAgezChroniczPOV_7      0.36      0.82    -1.24     1.96 1.00    10410     3178
szAgezChroniczPOV_8     -0.44      0.67    -1.80     0.88 1.00     9052     3091
szAgezChroniczPOV_9      0.88      0.69    -0.50     2.23 1.00     7456     3230

Family Specific Parameters:
      Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma     1.14      0.01     1.11     1.16 1.00     8104     2657
```

4. Medicaid claims data model

```
Family: MV(hurdle_lognormal, hurdle_lognormal, hurdle_lognormal, hurdle_lognormal, 
hurdle_lognormal) 
  Links: mu = identity; sigma = identity; hu = logit
         mu = identity; sigma = identity; hu = logit
         mu = identity; sigma = identity; hu = logit
         mu = identity; sigma = identity; hu = logit
         mu = identity; sigma = identity; hu = logit 
Formula: I ~ 1 + Male * zAge + zChronic + (1 | ID) 
         hu ~ 1 + Male * zAge + zChronic + (1 | id | ID)
         O ~ 1 + Male * zAge + zChronic + (1 | ID) 
         hu ~ 1 + Male * zAge + zChronic + (1 | id | ID)
         M ~ 1 + Male * zAge + zChronic + (1 | ID) 
         hu ~ 1 + Male * zAge + zChronic + (1 | id | ID)
         P ~ 1 + Male * zAge + zChronic + (1 | ID) 
         hu ~ 1 + Male * zAge + zChronic + (1 | id | ID)
         D ~ 1 + Male * zAge + zChronic + (1 | ID) 
         hu ~ 1 + Male * zAge + zChronic + (1 | id | ID)
   Data: model_dataset (Number of observations: 15879) 
Samples: 4 chains, each with iter = 6000; warmup = 1000; thin = 1;
         total post-warmup samples = 20000

Group-Level Effects: 
~ID (Number of levels: 1744) 
                                   Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(I_Intercept)                        0.44      0.20     0.03     0.78 1.01     1700     3666
sd(hu_I_Intercept)                     1.41      0.20     1.04     1.83 1.00     1820     6425
sd(hu_O_Intercept)                     1.62      0.06     1.50     1.74 1.00     9244    12748
sd(hu_M_Intercept)                     1.62      0.05     1.52     1.73 1.00     9096    12325
sd(hu_P_Intercept)                     2.17      0.07     2.04     2.31 1.00     7717    10868
sd(hu_D_Intercept)                     1.44      0.10     1.26     1.64 1.00     6357    10560
sd(O_Intercept)                        0.81      0.03     0.75     0.88 1.00     7136    12394
sd(M_Intercept)                        0.57      0.02     0.52     0.61 1.00     9227    13467
sd(P_Intercept)                        1.21      0.03     1.15     1.27 1.00     3742     7820
sd(D_Intercept)                        0.22      0.11     0.02     0.43 1.00     2522     4449
cor(hu_I_Intercept,hu_O_Intercept)     0.73      0.08     0.56     0.87 1.02      286      650
cor(hu_I_Intercept,hu_M_Intercept)     0.75      0.07     0.59     0.89 1.01      230      279
cor(hu_O_Intercept,hu_M_Intercept)     0.71      0.02     0.66     0.76 1.00     7571    12817
cor(hu_I_Intercept,hu_P_Intercept)     0.49      0.09     0.30     0.66 1.01      277      424
cor(hu_O_Intercept,hu_P_Intercept)     0.64      0.03     0.58     0.69 1.00     5819    10436
cor(hu_M_Intercept,hu_P_Intercept)     0.79      0.02     0.76     0.82 1.00     7406    12966
cor(hu_I_Intercept,hu_D_Intercept)     0.25      0.14    -0.02     0.51 1.01      357      828
cor(hu_O_Intercept,hu_D_Intercept)     0.29      0.06     0.18     0.41 1.00    10725    15636
cor(hu_M_Intercept,hu_D_Intercept)     0.38      0.05     0.28     0.48 1.00    12809    15613
cor(hu_P_Intercept,hu_D_Intercept)     0.40      0.05     0.30     0.50 1.00    12920    16354

Population-Level Effects: 
               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
I_Intercept        8.89      0.16     8.58     9.21 1.00    21787    16667
hu_I_Intercept     4.90      0.27     4.41     5.47 1.00     1422     6191
O_Intercept        5.74      0.07     5.61     5.88 1.00     8621    12871
hu_O_Intercept     0.49      0.11     0.27     0.71 1.00    10158    13361
M_Intercept        5.42      0.05     5.33     5.51 1.00    11171    14363
hu_M_Intercept    -0.69      0.11    -0.90    -0.48 1.00     9080    12413
P_Intercept        4.57      0.08     4.41     4.73 1.00     2558     5717
hu_P_Intercept    -1.41      0.15    -1.69    -1.12 1.00     9779    13055
D_Intercept        5.04      0.09     4.86     5.21 1.00    31497    16373
hu_D_Intercept     3.63      0.16     3.33     3.95 1.00    14340    15565
I_Male             0.14      0.20    -0.24     0.53 1.00    22310    15625
I_zAge             0.35      0.26    -0.16     0.86 1.00    18640    15931
I_zChronic        -0.01      0.14    -0.28     0.26 1.00    13667    14296
```

```
I_Male:zAge        -0.09       0.38    -0.84     0.65 1.00    20079    16899
hu_I_Male          -0.24       0.25    -0.73     0.25 1.00    21402    16517
hu_I_zAge           0.37       0.35    -0.32     1.06 1.00    13992    14891
hu_I_zChronic      -1.62       0.22    -2.05    -1.19 1.00     6825    11333
hu_I_Male:zAge     -0.62       0.50    -1.61     0.35 1.00    16033    15356
O_Male              0.05       0.08    -0.10     0.20 1.00     9507    13620
O_zAge              0.39       0.10     0.20     0.58 1.00     8437    12314
O_zChronic          0.28       0.07     0.15     0.41 1.00     8846    12984
O_Male:zAge        -0.33       0.15    -0.63    -0.04 1.00     9419    12128
hu_O_Male           0.48       0.11     0.27     0.69 1.00    10413    14088
hu_O_zAge           0.25       0.14    -0.02     0.52 1.00     7979    12173
hu_O_zChronic      -1.76       0.10    -1.97    -1.56 1.00     8391    12484
hu_O_Male:zAge     -0.25       0.20    -0.64     0.15 1.00     9544    13112
M_Male             -0.05       0.05    -0.14     0.05 1.00    12025    14856
M_zAge              0.16       0.07     0.03     0.29 1.00    10231    13725
M_zChronic          0.27       0.05     0.19     0.36 1.00    10729    14280
M_Male:zAge        -0.03       0.10    -0.23     0.17 1.00    11032    14208
hu_M_Male           0.61       0.10     0.42     0.81 1.00     9499    12649
hu_M_zAge           0.27       0.13     0.01     0.54 1.00     7510    11985
hu_M_zChronic      -1.95       0.10    -2.15    -1.76 1.00     8275    12726
hu_M_Male:zAge     -0.17       0.19    -0.55     0.20 1.00     8439    12221
P_Male             -0.07       0.09    -0.24     0.10 1.00     3052     5388
P_zAge              0.42       0.11     0.21     0.63 1.00     2944     6374
P_zChronic          0.69       0.07     0.54     0.84 1.00     2657     5592
P_Male:zAge        -0.14       0.17    -0.48     0.19 1.00     3143     6377
hu_P_Male           0.79       0.13     0.54     1.05 1.00    10358    13065
hu_P_zAge           0.09       0.17    -0.25     0.42 1.00     7346    11145
hu_P_zChronic      -2.51       0.13    -2.78    -2.26 1.00     8334    11681
hu_P_Male:zAge     -0.71       0.25    -1.20    -0.23 1.00     8156    12633
D_Male              0.20       0.09     0.02     0.39 1.00    30335    16576
D_zAge             -0.18       0.11    -0.40     0.04 1.00    21928    16158
D_zChronic         -0.08       0.08    -0.25     0.08 1.00    27310    16423
D_Male:zAge        -0.12       0.17    -0.46     0.22 1.00    22830    15607
hu_D_Male           0.25       0.14    -0.03     0.52 1.00    16883    16435
hu_D_zAge           0.44       0.18     0.08     0.80 1.00    12421    15030
hu_D_zChronic      -0.62       0.13    -0.88    -0.37 1.00    13946    14235
hu_D_Male:zAge     -0.62       0.27    -1.15    -0.10 1.00    14262    14293

Family Specific Parameters:
        Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma_I     0.76      0.12     0.53     0.98 1.01     2056     5287
sigma_O     1.07      0.02     1.04     1.11 1.00    17614    15334
sigma_M     1.02      0.01     0.99     1.04 1.00    23069    15214
sigma_P     0.92      0.01     0.90     0.94 1.00    23784    15883
sigma_D     0.93      0.04     0.85     1.00 1.00     5500    11237
```

5. Direct insurance utilization model

This model is only used to estimate the standardized health care costs of individuals who might be crowded-out of the direct insurance market. The data is similar to the MEPS model, but restricted to individuals with directly-purchased insurance.

```
Family: hurdle_lognormal Links: mu = identity; sigma = identity; hu = logit
Formula: UScore ~ 1 + s(Chronic, k = 3) + s(zAge, k = 3) + Male + Race + Education + zPOV + (1 |
VARSTR)
         hu ~ 1 + Chronic + zAge + Male + Race + Education + zPOV + (1 | VARSTR)
   Data: model_dataset (Number of observations: 3942)
Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
         total post-warmup samples = 4000

Smooth Terms:
                Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sds(sChronic_1)     0.77      0.59     0.03     2.19 1.00     3596     1865
sds(szAge_1)        0.58      0.49     0.02     1.85 1.00     2758     2301

Group-Level Effects:
~VARSTR (Number of levels: 165)
                 Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(Intercept)        0.13      0.05     0.02     0.22 1.00      709      932
sd(hu_Intercept)     0.23      0.07     0.06     0.35 1.00      871      591

Population-Level Effects:
                     Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
Intercept                7.05      0.28     6.50     7.59 1.00     1520     2221
hu_Intercept            -0.32      0.34    -1.01     0.34 1.00     1497     1891
Male                    -0.30      0.04    -0.39    -0.22 1.00     9360     2789
RaceAsian               -0.23      0.28    -0.76     0.32 1.01     1514     2275
RaceBlack               -0.24      0.27    -0.76     0.29 1.00     1474     2211
RaceHispanic            -0.30      0.27    -0.83     0.24 1.01     1483     2256
RaceOther                0.08      0.29    -0.48     0.65 1.00     1478     2194
RaceWhite                0.10      0.27    -0.41     0.64 1.00     1482     2055
EducationGraduate        0.05      0.13    -0.20     0.31 1.00     5659     3358
EducationHSDGED          0.01      0.07    -0.13     0.15 1.00     3229     3221
EducationNodegree       -0.13      0.10    -0.32     0.06 1.00     4123     3376
EducationOther           0.02      0.10    -0.19     0.22 1.00     4185     3128
EducationUnknown         0.04      0.08    -0.12     0.19 1.00     3151     3251
zPOV                    -0.07      0.03    -0.12    -0.02 1.00     7883     2623
hu_Chronic              -0.80      0.07    -0.93    -0.67 1.00     6464     3107
hu_zAge                  0.09      0.05    -0.01     0.18 1.00     5901     2926
hu_Male                  0.65      0.07     0.51     0.79 1.00     6943     3144
hu_RaceAsian            -0.24      0.34    -0.91     0.43 1.00     1463     2071
hu_RaceBlack            -0.14      0.33    -0.77     0.52 1.00     1460     2128
hu_RaceHispanic         -0.22      0.32    -0.86     0.43 1.00     1442     2089
hu_RaceOther            -0.87      0.36    -1.57    -0.15 1.00     1686     2301
hu_RaceWhite            -0.93      0.33    -1.56    -0.28 1.00     1450     1876
hu_EducationGraduate    -0.53      0.24    -1.00    -0.07 1.00     5499     2784
hu_EducationHSDGED       0.31      0.12     0.07     0.56 1.00     2658     3197
hu_EducationNodegree     0.28      0.16    -0.02     0.58 1.00     3473     3412
hu_EducationOther        0.09      0.18    -0.27     0.44 1.00     3445     3257
hu_EducationUnknown      0.11      0.13    -0.14     0.36 1.00     2976     3267
hu_zPOV                 -0.00      0.05    -0.09     0.08 1.00     9087     2908
sChronic_1              -0.36      0.03    -0.41    -0.29 1.00     4413     2831
szAge_1                 -0.14      0.03    -0.20    -0.08 1.00     7076     3182

Family Specific Parameters:
      Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma     1.09      0.02     1.06     1.13 1.00     5269     2557
```